COMPRESSED AIR MAGAZINE

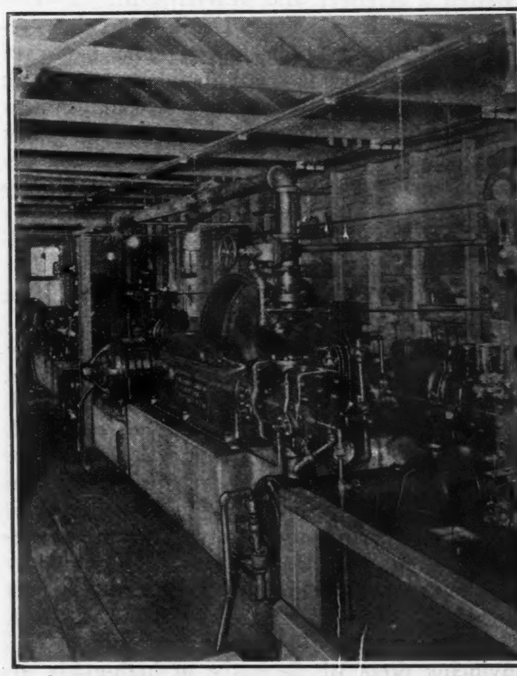
Vol. XXIV DECEMBER, 1919 No. XII

Rapid and Economical Sinking of a Great Mine Shaft

THIS SHAFT, known as the "H" shaft of the Pabst mine of the Oliver Iron Mining Company, Ironwood, Michigan, with outside dimensions of 18 ft. 4 in. by 11 ft. 4 in., and having when completed one cage compartment, 10 ft. by 5 ft. 8 in.; two skip compartments, each 5 ft. by 6 ft.; one pipe compartment, 3 ft. 8 in. by 5 ft. and one ladder compartment, 3 ft. 8 in. 5 ft., a vertical depth of 1,830 ft.—more than a third of a mile, and involving the removal of more than 14,000 cubic yards of rock—was begun on June 20, 1917, and completed in March, 1919, which means not merely that the above depth was reached but that the shaft was entirely ready for service from top to bottom.

When the work was started it had been decided to make each part of the job as complete as possible while the sinking proceeded, for it was believed that in the long run time would be saved by so doing, rather than to push the sinking first and complete the steel work and equipment later, so that as the shaft went down all steel sets, bearers, dividers, concrete lath and skip runners were placed, and, in addition, all stations were cut, pockets built, and cages and buckets put into operation. It is believed that the progress made was a record for the district, with no serious accident from start to finish. A clear and most satisfactory account of this work has been prepared by Mr. A. J. Wagner for *Engineering and Mining Journal,* his narrative being here reproduced with one or two added illustrations.

The long axis of the shaft was placed perpendicularly to the strike of the formation, taking the natural ground slippage on the end of the shaft. This is the first shaft so situated on the Gogebic Range. In sinking, the first nine feet was overburden, and this was followed by slate that continued to a depth of 725 ft. At this

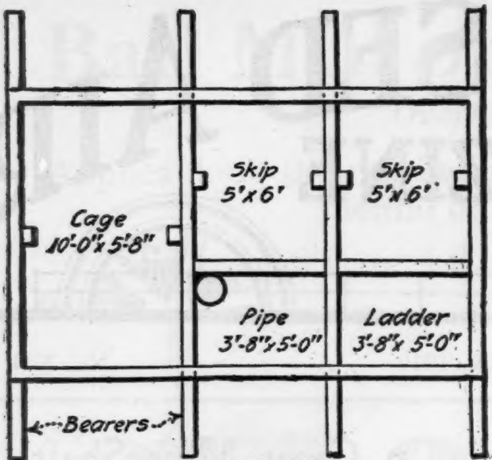


1—COMPRESSOR PLANT AT PABST MINE

point granite was cut, and granite with dikes continues to the bottom of the shaft.

The sinking crew consisted of eight miners and one shift boss on each of three eight-hour shifts, making a total of 27 men. These men performed all the work in the shaft, such as drilling, charging, blasting, mucking, and timbering.

The drill equipment at the beginning consisted of twelve Butterfly Jackhamers, Type BCR430, equipped with 7/8-in. hollow hexagon steel and four-point bits. These were used in the slates to a depth of 589 ft., at which point harder ground



2—PLAN OF PABST H SHAFT

required a stronger and heavier drill. Twelve Jackhamer sinkers, Type DDRW13, then replaced the Butterfly machines. The factor of primary importance in speed of sinking is to break the ground, and the remarkable accomplishment of the drilling machines used in the "H" shaft made possible the fast record. As will be detailed later, a nine-foot sink the full size of the shaft was drilled, charged, and blasted in eight hours, the actual drilling of the full round, totaling 442 ft., requiring from five to six hours. The drilling time from start to finish of a nine-foot hole in granite averaged thirty minutes.

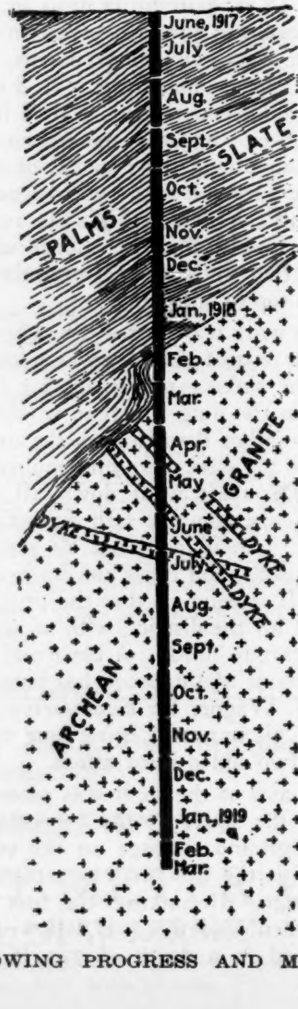
When material was removed from the shaft at the end of each drilling period the eight used drill machines were sent to the shop with the drill steel, and each machine was opened, inspected, cleaned, and lubricated before it was returned to the shaft. The result was an extremely low maintenance cost and a uniformly high drilling efficiency. The warehouse record shows a maintenance cost for the year 1918 to have been only $2.51 per month per machine. As each machine drilled 6,000 lineal ft. in hard ground, the cost of maintenance was $.005 per foot drilled. As convincing proof of the value of high-grade inspection and careful lubrication it may be stated that, upon completion of the shaft, the drills were mounted and placed in service on the main level drift and on sinking work at other mines.

As 7/8-in. hollow hexagon steel was in stock, this size was used in the sinkers, although they were designed to use 1-in. steel. The drill steel was made up with two-foot starters, and the last drill was eleven feet long. The bits were standard four-point with a 90° cutting edge and 5° and 14° taper. The gage of starters was 2 1-3 in., with 1/8-in. change in gage and 18-in. change in length. The steel was machine sharpened at the collar of the shaft in a No. 5 Leyner sharpener. No difficulty was encountered with steel breakage or inability to make the drills "follow."

Air for the machines was supplied by a 6-in. air pipe provided with a standard manifold. A specially designed header was discarded early in the work, as its use was found to be troublesome.

The cut was drilled so as to remove, when blasted, a "V" at the center of the shaft, and consisted of five rows of five holes in each half of the shaft, with three extra holes drilled straight down across the center of the shaft. An accompanying diagram shows a plan and section of the distribution of the holes.

In the diagram fifty-three holes are shown. In slates fifty holes were drilled, the three center holes marked *"B"* being omitted. The numbers on the holes refer to the order of blasting. The three holes marked *"B"* were shot by means of a battery to relieve the cut. The holes numbered 1 were fired first; 2, second, and the others in rotation, and the row numbered 1 was fired first;



3—SHOWING PROGRESS AND MATERIAL

4—SHAFT SINKING CREW

row 2, second, and succeeding rows in like order, the rows up to 6 being shot and then this part mucked out. Rows 7, 8, 9, and 10 were next fired in sequence, completing the cut. By firing in this order a wiggle, or staggered, effect was obtained, throwing the dirt from side to side, breaking any big blocks loosened, saving the shaft timber from damage, and putting the entire charge off as it was timed to go, without prematurely exploding other holes. Delayed fuses were used and the holes charged with eight sticks of 80 per cent Red Cross gelatine, the detonator being placed in the fourth stick from the bottom. This arrangement is contrary to the rule for placing the detonator, but owing to the fact that the holes are close together, the collar often breaks prematurely and tears out the detonators that have not been exploded. When this happens some of the holes do not explode and too much burden is placed on other holes.

No cut failed to be pulled clean, and not one steel shaft set was bent, although the sets were kept within fifteen to twenty feet of the bottom. The blasts were timed so close together that the effect was to blend the concussion in one slow, rattling blast.

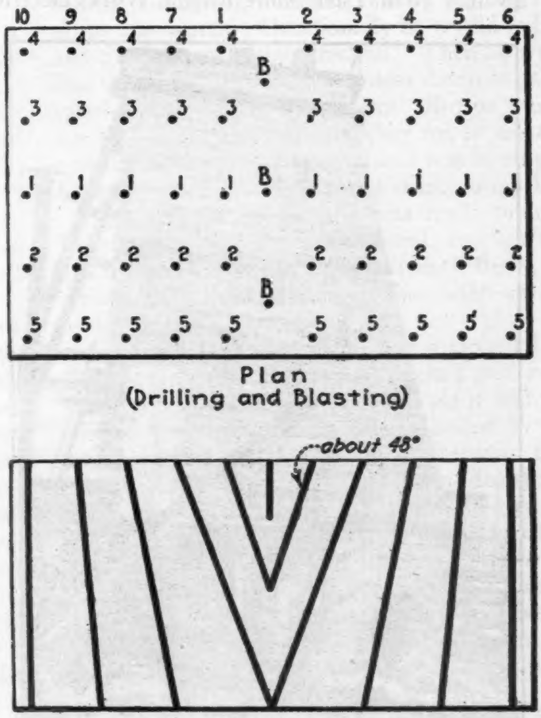
After blasting, the muck was hoisted in two 20-cu. ft. sinking buckets, provided with special guides. At the trestle landing the buckets were dumped while hanging straight on the cable, the rock falling on an inclined shaft cover. This sloping cover was hinged, provided with high sides that forced a chute, and was swung in and out of position by means of air-operated cylinders. The complete cycle of work in sinking was as follows:

TIME REQUIRED PER CYCLE OF WORK IN SINKING PABST "H" SHAFT

Operation	Time, Hours
Take down material and drill entire cut	6.0
Charge holes (first blast)	1.0
Remove material and blast	1.0
Blow smoke	1.5
Muck first blast	8.0
Charge second blast and fire	0.5
Blow smoke	1.5
Muck second blast	6.0
Hoisting water with bucket, per day	1.5
Timbering, per set	5.5
Cutting and blasting hitches	8.0
Installing bearers	3.0

The shaft sets extending through the encountered slates are made of 8-in., 34-lb., "H"-section steel and 6-in., 22.8-lb., "H"-section throughout the remainder of the shaft. They were spaced at 5-ft. centers. Dividers were of steel. Bearers were placed every 100 ft. in depth, four bearers to a set, one under each end plate and one under each cross divider. The bearers are 12-in., 31.5-lb. I-beams, 17 ft. long, cut in the middle for purpose of installing and spliced after being placed. Hitches 3½ ft. deep were cut to fit the steel, and this was done by drilling one side and the bottom of each hitch, the holes being placed side by side, each hitch requiring nine holes. Iron wedges secure the bearers.

The lath or lining consisted of pre-cast concrete slabs 8 in., 10 in., and 12 in. wide by 4 ft. 10 in. long and 3 in. thick in the slates and 2 in. thick in the granite. The slabs were designed



5—ORDER FOLLOWED IN BLASTING

with one vertical edge on each face, beveled to permit easy installation, and held in place by angles riveted to the "H" sections. The lath was wedged from the rear with cedar blocking. Men and material were handled on a cage, and dirt

6—HOISTING COMPARTMENTS, COLLAR OF SHAFT

was hoisted by buckets, the three hoisting compartments being used.

The equipment on surface was temporary, buildings and headframe as well as machinery. The machinery used was as follows:

Cage Hoist—One herringbone-geared drum, 48 in. x 36 in. Lake Shore Engine Works electric hoist driven by 112-hp. 440-v., slip-ring, General Electric induction motor.

Rock Hoist—One of two drum, 48 in. x 36 in. herringbone-geared, Lake Shore Engine Works Electric hoist driven by 150-hp., 440-v., slip-ring, General Electric induction motor.

Surface Haulage—One Armstrong haulage plant, rawhide pinion and iron cut spur gear, geared to handle cars at 900 ft. per min., driven by 220-v., 50-hp., Westinghouse induction motor.

Air Compressors—Two 12-in. and 7½ in. x 12 in. Imperial, compound, short-belt drive, Ingersoll-Rand air compressors, each of 327 cu.ft. displacement at 210 r.p.m. and driven by 440-v., 50 hp., General Electric slip-ring, induction motors running at 1,200 r.p.m.; one 14 in. x 12 in. N. S. B. E., Chicago Pneumatic Tool Co. air compressor, of 487 cu.ft. capacity at 230 r.p.m., driven by 100 h.p. Burks, 220-v., slip-ring, induction motor running at 900 r.p.m., and one No. 5 Leyner drill sharpener.

The work of sinking this shaft was in charge of Gustaf Erickson, mining captain, and under the direction of A. G. Hedin, head mining captain. A. J. Wagner, writer of the above, was in charge of drills and responsible for their performance.

7—HEAD HOUSE OF SHAFT H

"In the end, the prosperity of a people always bears a true relation to their capacity for production. If the capacity for production be interfered with, as it always must be when workmen are discontented, because they feel that they unfairly share in the profits of industry and because of economic fallacies to which they cling that result in a conscious limitation of production, then the limits of national prosperity are sharply bounded, no matter what the richness of natural resources may be.

"Therefore I believe that the measure of our future prosperity in America is definitely related to the wisdom with which we work out the relationship between capital and labor. That relationship will never be wisely worked out in an atmosphere of economic ignorance. There is quite as much of that ignorance in the managing offices as there is in the factories."—Frank A. Vanderlip in "What Happened to Europe."

A War Adventure of the Air

NOTE—*The author of "High Adventure" told in a recent issue of U. S. Air Service the thrilling tale that follows, of a fight in which an anti-aircraft shell lodged between the cylinders of his rotary engine—but failed to explode. Capt. Hall served in the British Army fifteen months, and with the celebrated Lafayette Escadrille from June, 1917, to February, 1918. He had a most exciting career as a fighting pilot in the war. He was wounded and brought down in No Man's Land, June 26, 1917; resumed active service, Sept. 15, 1917; was transferred to U. S. Air Service, February, 1918; wounded, brought down and captured, May 7, 1918. Omissions from his article are indicated by asterisks.*—THE EDITORS.

By JAMES NORMAN HALL

EDDIE RICKENBACKER, Eddie Green, and myself—all pilots of the 94th Pursuit Squadron, U. S. A.—were on *alerte* duty at our aerodrome at Toul. It would be impossible to forget that fine Spring morning—May 7, 1918, to be exact—when, as the result of a combat and a series of bizarre accidents which happen only in the air, I found my plane tumbling completely out of control at a point about five kilometers back of the enemy's lines. We took the air in response to a telephone call from an infantry observation post. An enemy formation was reported approaching our lines in the vicinity of Pont-a-Mousson. After a twenty-minutes search we sighted it, five Albatross single-seaters, north and west of that town.

At that period the 94th was equipped with a new and untried plane, the new Nieuport, type 28, single-seater, rotary motor, lower wing ailerons, a machine built by the French Nieuport Company. It was a splendid little craft—for pleasure purposes. It climbed rapidly, manoeuvred well, and was better than the Spad for acrobacy. But it had been rejected by the French Government as being not strong enough to weather the tremendous strain to which fighting planes are subject in combat.

The United States Air Service had been compelled to accept them as plane equipment for the 94th, but newly arrived at the front, for the French were not then able to live up to their agreement to furnish American pursuit squadrons with Spads, their best type of combat machine. All of which explains the "series of bizarre accidents;" for had we been flying trusty old Spads I should not have had to cool my heels in a *kriegsgefangenen lager,* "ground-flying," after the fashion of aviator prisoners of war.

The combat started at 14,000 feet. Having the advantage of the enemy in altitude, we attacked immediately, they being compelled to dive further into their own lines because of their inferior position. While diving vertically upon the enemy nearest me, the fabric covering the upper surface of my upper right plane burst along the leading edge, throwing the plane completely out of balance. Compelled to leave the combat immediately, I turned toward our lines, which could be seen in the distance, but oh! so unalterably in the distance.

The wide rent in the fabric of the wing increased in size under the steady encouragement of the wind. Other strips ripped loose and flapped and fluttered out behind. Enemy anti-air-craft fire was brisk and increasingly accurate during that precarious journey homeward. Owing to the damaged wing I was unable to manoeuvre.

It was a moment of intense excitement. All airmen have known similar ones when their hopes of safety hung in a balance jauntily swaying back and forth, with old Godfather Chance jiggling the scales in a purely vindictive mood. Looking behind and below me I saw my former quarry become huntsman, climbing toward my level for all he was worth. Occasionally he would pull up and fire a burst in my direction. Then he would lose speed, fall off on a wing, nose down to gather speed and repeat the manoeuvre. But he was yet too far distant and too far below me to make accurate practice, and I knew that I was in no great danger from him till he could climb to my level.

The bark of the Archies was really ominous. When those dogs are on the scent, and one's old bus is worn out and incapable of swift flight, how vicious they seem, and how they snap at one's heels!

Suddenly I felt my plane give a violent lurch. The motor spilled forward, wrenched partly loose from its bed, and down we went, plane and pilot, toward that inhospitable land bounded by German trenches. It was not until afterward that I learned the reason for the sudden descent. A small incendiary shell from a quick-firing gun had struck my engine. It stuck there, and failed to explode, but ended for all time the delicate functioning of that marvelous little Rhone motor.

I wondered in that peculiarly objective way which is the most amazing thing to reflect upon afterward, what the result of this adventure was to be. I believed at the moment that I didn't much care, for I had read many stories of the treatment by the enemy of allied prisoners of war. Death seemed a preferable fate.

The suspense was not long drawn out. Aerial troubles bring intense anxiety, but they have the merit of passing almost with the swiftness of

thought. I remember the elemental roughness of Mother Earth's welcoming embrace, a shock of pain in legs and head, and then, despite my fear of German prison camps, the great surge of joy at the consciousness of being alive. After all, life is sweet, and a few moments of illuminating experience taught me how much more truthful one's instincts are than professed beliefs.

I thought that I wanted to be killed, but nature knows what is good for us and doesn't take any stock in our melodramatics. At any rate, she very effectively overruled my impulse, if I really had one, to let matters take their course. She merely gave me a fleeting but vivid glimpse of a green field spinning up to meet me. And I gave a violent pull on my control stick in an effort to save myself from a too-hasty contact. The result was that I did not crash hopelessly, and now have behind me an experience which is, in a melancholy way, some compensation for the loss of freedom.

Seeing German soldiers rushing from all sides toward my machine, I expected rough usage, and scowled in what I thought must be true Hauptmann fashion, hoping to overawe them. This was a needless effort. One of the first men to reach me said: "You are hurt, Sir-r-r?" in good German English. I told him that I was, a little, whereupon he immediately called two others. They lifted me gently out of my seat, and carried me to a dugout at the edge of the wood. * * *

A good many soldiers followed me down into the dugout. I felt uneasy when I saw no officers among them, thinking: "This is where I lose my few possessions, and Lord knows when I'll get a new outfit of clothing." However, although they could have taken everything from me in the absence of their officers, and no one any the wiser, no attempt was made to do it. Instead of that, an elderly German orderly brought me a cup of hot coffee from a compact little kitchen adjoining the messroom. * * *

An ambulance man came, and in a jiffy he had my right leg in splints and carefully bandaged, and my head bound up, (both ankles and my nose had been broken in the fall, the right ankle rather badly.) Then I was given a German cigarette and began to think: "This is not going to be so bad as I expected." The soldiers cleared out in a hurry upon the arrival of an officer. He saluted with a stiff little bow from the hips, as Germans always do, told me in English that he was sorry, but "fortunes of war," and so on. Then he asked if I would let him see my papers. Luckily I had nothing but 800 francs in money—it was the first of the month—and my identification card. At least I thought I had nothing else, although later I found a typewritten sheet of squadron orders in my trousers pocket. In a moment of unguarded leisure I chewed this up and swallowed it, my stomach receiving the morsel not gladly, but in a spirit of admirable resignation. The officer kept the card, returning my pocketbook and money, accepting my word for it that I had nothing else.

About half an hour after this several other officers, aviators, arrived. Each of them saluted and bowed in the same smart, soldierly, but rather odd way. Then one of them said that they had had the honor—a nice way to put it, I thought—of fighting with my patrol that morning, and that my two comrades had returned safely. Without any apparent bitterness, he added that, as a result of the combat, a pilot of their squadron had fallen in flames and was burned to death. (This machine was brought down by Eddie Rickenbacker, needless to say, a fine *chasse* pilot.) He inquired about my injuries, and told me that the nearest hospital was at some distance. If I could endure the delay they would be glad to have me lunch with them at their squadron headquarters which was not far out of the way. I accepted with a good deal of reluctance, not feeling in a company mood, but brightened at the thought of what had just been happening. This might have been a conversation among friends in front of the Café de la Paix in Paris.

As they carried me to their car, I felt more like a pampered Back Bay baby going for an airing in the Boston Public Gardens than a prisoner of war. They left me in the car at the side of the road, while they went over to have a look at my wrecked machine. This gave me a moment for collecting my thoughts.

I had often been warned that a prisoner must be very much on his guard. I had heard that a favorite German ruse with a captured aviator was to take him to a squadron mess, wine and dine him, particularly the first, so that he might forget his caution. Then when he was sufficiently mellow, they pumped him dry of information and sent him on his way, feeling well repaid for their liberal expenditure of good Rhine wine.

Sometime, so I had been told, they tried browbeating a good deal depending upon their estimate of the captive. I hoped that this latter would be the method chosen with me. It is hard to be suspicious of courteous and hospitable treatment; but one can easily meet an attack which is a straightforward attempt at "bulldozing." I knew, of course, that prisoners have their rights and cannot be forced to talk.

I had a homesick moment while sitting there, waiting for them, thinking of the uncertain future, aware that for me even an attempt at escape was out of the question for months to come. Far in the distance I heard the faint drone of rotary motors, a sound high-pitched, familiar, terribly

saddening under those circumstances. It could come, I knew, from the craft of only one squadron, the 94th.

Soon I saw them, flying very high, almost directly overhead, the motors humming drowsily. They were moving unconcernedly on, tipping up now and then in a steep bank, making jaunty earth-scrutinizing changes of direction which told me that they were perhaps searching for some trace of me.

I wanted to shout, to wave my hand, to pull myself by my boot tops away from the solid earth. If only I could have reached up far enough to tighten my fingers around a tail skid, I felt that I could hang on long enough to be carried across that little strip of enemy ground. Then I could have dropped into the Moselle where it flows through friendly territory. But they were miles above me, and so I sat there watching them, helpless and sick at heart. * * *

It was a ride of about fifteen kilometers to the aerodrome of the German squadron. I learned that these officers belonged to a combat group lying directly opposite our own sector of the front. Mars-le-Tour, the town near which they were stationed, had been a place of considerable interest to us. * * *

Evidently they were equally curious. Had it not been wartime, and had I been in a more comfortable frame of mind, we might have had a most interesting chat, comparing notes as to time and place of combats. Some of them spoke French and others English, so that there was no difficulty in conversing. But I had to keep clear of the subject, lest I should disclose, even approximately, the location of our squadron. My German hosts, or captors—I hardly knew in which light to consider them then—respected the difficulty of my position and asked no embarrassing questions. I could, however, talk quite freely with my opponent of the combat, an experience somewhat unique for two enemy airmen. We chatted informally and pleasantly of our encounter and compared notes as to our feeling at the times when we were pursuer and pursued. * * *

While we were waiting for lunch one of the men sat down to the piano and played some French music, songs which I had heard in our own mess only a day or two before. For a moment I was tempted to let my preconceived notions of the Germans go to the deuce, and talk as one human being likes to talk to another. I wanted to let down the barrier of reserve, as they seemed ready to do. Then came the suspicion: "This is doubtless a part of the game. First the mellowing influence of music, then that of wine, and then the indiscreet disclosures." These ever-ready suspicions may see a trifle ridiculous; but it is far better that a prisoner of war be too cautious than not cautious enough. Furthermore, American aviators were rareties on the German side of the lines at that time, and I knew that the enemy were mighty curious about the plans and the organization of our air force.

Well, the wine proved to be *café au lait!* First we had a roast, then a salad, dessert, and the coffee to wind up with. No wine, no liquors of any sort. * * *

Everything was open and above board in so far as I could judge. None of the officers felt it his duty to act as a self-appointed intelligence officer. I was even informed beforehand that one acting in that capacity was coming soon to see me, so that I was ready for him when he did appear.

He was a man of about 45, erect, soldierly looking, with a pleasant face, not at all the Prussian type of official I had expected to see.

He greeted me in a jovial sort of way with: "Well, Hall, tell us all about it. What are you people doing over there?"

I thought to myself "Watch your step! That hearty, last-name sort of greeting does very well in America, but it isn't a German practice."

However, it certainly seemed natural enough, and I decided that I could meet apparent friendliness with apparent friendliness without damaging the allied cause greatly. So I said:

"All right, Major; you know how we Americans love to brag. Ask me whatever you want to know."

He began by asking me what my belief was about the treatment I should receive at the hands of my captors.

"Now, tell me frankly," he said, "haven't you expected that your ears would be cut off, or your tongue slit—something of that kind?"

I said that I had heard some pretty damning things relative to the German treatment of prisoners of war, but I knew that there were good Germans as well as bad ones, and was relieved (subtle flattery) to find that I had fallen into the hands of the decent ones.

* * *. It was now my turn to answer or to refuse to answer questions. However, I was first told by this officer what he knew, or thought he knew, of the movements of our troops and the organization of our air force; what squadrons were on the front, what others were soon to be there, and so on. He told me also of the movements of British and French squadrons, and showed me photographs of allied aerodromes along the Meuse and Toul sectors. * * *

He told me that he knew exactly where my squadron was located and how long it had been there; but evidently he did not, for he was anxious that I should either confirm or deny his state-

ments. Finally, weary of persistent questioning, I said:

"I tell you what I'll do, Major. I will leave the matter to these officers. Supposing one of them to be in my position as a prisoner, questioned by one of our intelligence officers. If any one of them will honestly say that, under such conditions, he would be willing to give the location of his squadron headquarters, I'll tell you where mine is."

Although I would have found a way out of it, it would have been awkward not to have fulfilled this promise had there been occasion for doing so. But those pilots were gentlemen. All of them said that in my place they would do as I was doing.

The Major was a decent old fellow, and didn't question me any further. On several after occasions he sent greetings on to me by other American aviators who passed through his hands.

After the examination, my airmen hosts—they had proved to be hosts after all—ordered their car, and the Major and an officer from group headquarters went with me to the war hospital at Jarny, not far from Metz. * * *

I must not forget to speak of another courtesy extended me by the pilots of this German squadron which, I believe, cost the pilot who did it his own freedom. It is a practice among airmen at the front, in case of the capture of an enemy pilot, to drop a message giving this information on his own side of the lines. I had asked if this might be done for me, adding, for caution's sake, that they might throw it out somewhere between Verdun and the Vosges Mountain. They replied that they would willingly deliver such a message, and they did.

Some Americans from my own group, captured later, told me that the note was dropped and received, and that the German pilot who carried the message was shot down in our own lines by an allied airman who knew nothing of his mission. Since returning to France I have heard from other members of my group that the German airman who dropped the message was shot down and made a prisoner two or three days after he had delivered it. Major David Peterson, the man best able to give me the facts of the incident, has since been killed in an airplane accident, and I have not been able to get the exact truth of it.

On the way to the hospital I discovered that I had left my flying helmet and gloves in the dugout near the field where I fell. I spoke of this in some by-the-way fashion. I think I said that the helmet had a sentimental value which made me sorry to lose it. Two or three days later one of the pilots came to the hospital to see me, bringing both gloves and helmet. Not only that. He also brought two snapshots which he had taken on the morning I was shot down, one of my wrecked machane and one of myself, sitting in a motor car belonging to their squadron, souvenirs which are precious to me.

One glance at them carries me in a moment over the months and the miles to Pagny-sur-Moselle, and recalls vividly my last adventures in the war. To get these he had to make a journey of about thirty-five kilometers. On several occasions the German pilots from Mars-le-Tour flew very low past my window at the hospital, waving to me as they went out or returned from patrol. They were sportsmen and gentlemen, and I should be glad to meet them again.

So much for my early treatment at the hands of the Germans. There followed six months of captivity, first at the German war hospitals at Jarny, in occupied French territory, and at Saarbrücken, Rhineland; then in the prison camps at Rastatt and Karlsruhe, Baden, and at Landshut, Bavaria. The rest of the story may be told briefly in the words of a fellow-aviator, likewise a *kriegs-gefangener*: "Wonderful people, wonderful country, and, oh! such exquisite soup!"

AIR MACHINERY EXPORTS

The Division of Statistics of the Bureau of Foreign and Domestic Commerce, Department of Commerce, furnishes the following figures on United States exports of air compressing machinery for the month of August, 1919:

Counties	*Dollars*
Denmark	65
France	89,833
Italy	18,089
Norway	7,040
Spain	11,872
England	25,803
Canada	22,965
Guatemala	33
Honduras	24
Salvador	163
Mexico	24,580
Newfoundland and Labrador	1
Trinidad and Tobago	1,067
Cuba	3,121
Dominican Republic	168
Argentina	2,510
Brazil	14,613
Chile	10,854
Peru	138
China	1,550
British India	5,369
Straits Settlements	5,700
Dutch East Indies	1,668
French East Indies	105
Japan	1,532
Australia	38,302
New Zealand	169
Philippine Islands	78
British South Africa	503
Total	$287,915

Development of the Rock Drill in America—Past and Present

By CHARLES AUSTIN HIRSCHBERG

NOTE.—***The subjoined article, narrating the history of the development of the rock drill in America, and which is one of the most comprehensive and authoritative treatises on the subject ever published, was prepared by Mr. Hirschberg of "Compressed Air Magazine" staff for the columns of our valued neighbor, "The Engineering and Mining Journal," through the courtesy of which periodical we are also able to publish it. The author might have carried this history a step further and shown how the rock drill is the real progenitor of many other pneumatic devices; for instance, the riveting gun and the chipping hammer, which latter are not original inventions, but are off-shoots of the same family.***—THE EDITORS.

COLORADO, known to many as the land of scenic beauty and mountain grandeur, is not only the playground of the tourist and the mecca for the followers of Isaak Walton, but is also the

FIG. 1. THE PROSPECTOR OF '49.

school of the inventor, brought about perhaps by the great industry of mining for gold, silver, platinum, radium, zinc, lead and many other minerals employed by man in the useful arts.

What better incentive could man want to spur him on to the ultimate goal of success than the

FIG. 2. PRIMITIVE ROCK DRILLING.

knowledge of its vast stores of wealth, and its sunshine, glowing from the heavens upon him like a benediction throughout 365 days of the year.

Cunning nature, running true to form, hid her treasures deep amid the hills, so that man must seek and toil to realize his desires, and so, from green valley to timber line and over the snow capped range we find tawny men beating trails to Colorado's treasure store in the fifties of the past century, bringing with them the pick and the shovel and the single jack and steel. This was the start of the gold fever in the State of Colorado.

Event succeeded event rapidly until 1879 when a new period set in with the discovery of the lead-carbonate silver ores of Leadville. It was about

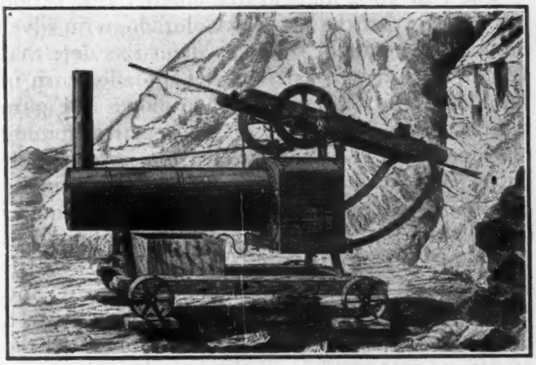


FIG. 3. THE COUCH ROCK DRILL—THE FIRST POWER ROCK DRILL.

this time that man put aside his single jack and steel in favor of the power rock drill, invented by J. J. Couch of Philadelphia in 1849 and perfected during the intervening years by Couch and J. W. Fowle of Boston, patent rights finally being purchased by Chas. Burleigh about 1866. The Burleigh drill was used in driving the Hoosac Tunnel in the year 1867.

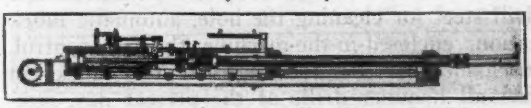


FIG. 4—FOWLE'S FIRST ROCK DRILL.

In 1871 another power rock drill was invented by Simon Ingersoll, and still other similar drills, such as that of Wood, Sergeant, Waring, Halsey and Githens, made their appearance. From this

time on, man's primitive hand methods of mining faded rapidly, giving way to the so-called reciprocating piston rock drill, which comprised a cylinder carrying a piston with a projecting end, to which was rigidly fastened a drill steel.

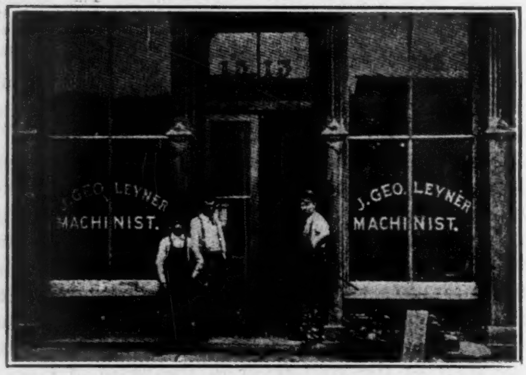


FIG. 5. J. GEORGE LEYNER'S FIRST MACHINE SHOP IN THE OLD BUSINESS SECTION OF DENVER. MR. LEYNER IS THE CENTER FIGURE IN THE DOORWAY. THIS PHOTOGRAPH WAS MADE IN THE EARLY NINETIES.

The year 1894 inaugurated another new period in the history of the State of Colorado, with silver mining predominant. It was about this date that J. George Leyner, a native of Colorado, born in Boulder County, opened the shop shown in Figure 5, in the City of Denver, for the repair of mining machinery. This enterprise led him into numerous experiments with the power rock drill, finally culminating in the invention of the first hammer drill about 1897, a type in which the piston moves freely in the cylinder and strikes upon the drill steel instead of being attached fixedly to it, and pushing it as in the reciprocating type of drill, a direct reversion to the principle involved in the primitive method of single jack and steel.

There is no questioning the debt which the mining industry owes to the invention of the reciprocating type of rock drill, but it remained for a Western man, Mr. Leyner, born and raised amidst the hustle and bustle of the mining camps of Colorado to take a real scientific step forward in the art of drilling rock. No need to dilate at length upon the things he accomplished in the invention and development of the hammer drill—the introduction of water and air through hollow drill steel for cleaning the hole, automatic lubrication, enclosed-in-the-machine throttle control, mechanical rifle-bar-rotating drill steel chuck—in fact all hammer drills of the present day, irrespective of maker, have borrowed their most important features from the Leyner Hammer Drill.

In testimony of the value and correctness of his theories, his business grew to a point where in 1905 he was forced to build a modern manufacturing plant at Littleton, Colo., to take care of a rapidly growing enterprise, finally ending in the purchase of license rights by the Ingersoll-Rand Co. of New York, since which time many modifications and refinements have been made, as typified in the Leyner-Ingersoll Drill.

Still another product of Colorado's inventive genius is the creation of the Stoper Drill, which depends for its success upon an air feed attachment to a drill cylinder, first experimented with by C. H. Shaw of the C. H. Shaw Pneumatic Tool Co., Denver, Colo., about 1906, followed rapidly by the Waugh Slugger, also an air feed type of machine, then the Crown Air Feed Drill of the Ingersoll-Rand, the Hardscog Wonder Rock Drill, the Sullivan, the Cleveland, the Leyner Stoper and the Chicago.

These inventions proved the progenitors of other styles of hammer drills, in fact the latter may be termed modifications of design of these first types. For instance, the majority of the early hand hammer drills (excepting plug drills, employed for drilling shallow holes in granite and stone) were largely patterned after the air feed

FIG. 6. THE FIRST SELF-ROTATING HAND HAMMER DRILL.

stoper, the air feed being eliminated and a spade handle substituted, in fact the manufacturers of these early stopers advertised the interchangeability of handle and air feed as a feature.

This early practice of interchangeability was, however, soon abandoned, for while good in theory it proved impracticable, and we then find the appearance of the Little Jap Drill, an Ingersoll-Rand product, followed rapidly by such machines as the Sullivan Hand Hammer Drill, the Hardscog Little Wonder, Cleveland Hand Drill, Leyner Brownie and numerous others.

In the year 1909 the first real self-rotated hand hammer made its appearance. Following the practice of making hand drills out of stopers, Mr. Leyner conducted extensive experiments with a Leyner drill cylinder removed from its shell. As will be seen from the illustration, Figure 6, he placed a T handle at the back with additional handles part way down the cylinder. He built several of these machines, more particularly for shaft sinking. However, before he had gone very far the Ingersoll-Rand Co. obtained a license to manufacture and sell under the Leyner patents, and as early as 1912 the Jackhamer, the first self-rotating hand hammer drill employing Leyner rifle bar and sleeve chuck rotation, was placed on the market. It proved such a success that other manufacturers brought out modified designs.

We often hear it said that there is nothing new under the sun. To some extent this saying may be applied to present day drill designs. Things which had been tried and tested in the early struggle with reciprocating drills, and later with the first Leyner Drills, but abandoned because of their failure to perform as expected, and again in the latter case, because of the impossibility of securing suitable materials and a lack of knowledge in those days of refined methods of heat treating to enable materials to stand up under the particular work they were to perform, are today making their appearance in the designs of many drills, and are exploited as "new."

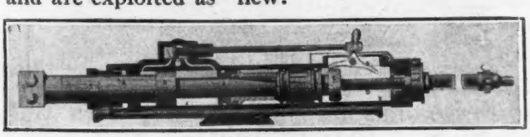


FIG. 7. THE BURLEIGH ROCK DRILL.

Referring to Figure 7, this shows the first reciprocating rock drill, as used by Burleigh in driving the Hoosac Tunnel in 1867, a project of construction fathered by the State of Massachusetts. The tunnel was 5 miles long driven through hard rock. It was an ambitious scheme for those days, involving at its start the employment of hand drilling. That the work in driving this tunnel was carried to a successful conclusion was largely due to the efforts of J. W. Fowle of Boston, who invented the Burleigh Rock Drill. Burleigh's part in the development of this early rock drill rested with certain improvements which he made

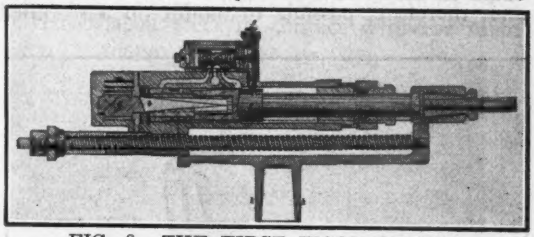


FIG. 8. THE FIRST WOOD DRILL.

as a mechanic in the shops of the Fitchburg Machine Works, where the machine was built.

The Wood Drill shown in Figure 8 was brought out shortly after the Burleigh Drill had made its appearance on the Hoosac Tunnel. In the testimony before the Massachusetts Legislature appears the following statement—"We were satisfied that this drill was an entire infringement

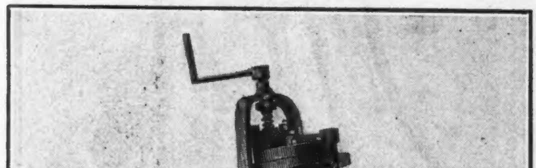


FIG. 9. THE INGERSOLL DRILL.

on Mr. Burleigh's patents, and that our obligations to Mr. Burleigh ought not allow us to suffer the Michigan Drill (Wood) to be used by our contractors."

The Ingersoll Drill as shown in Figure 9, which employed a tappet valve action and followed somewhat new lines of design in that it utilized a guide shell with feed screw for feeding the machine forward, making it very much lighter and, therefore, possible to mount on a so-called

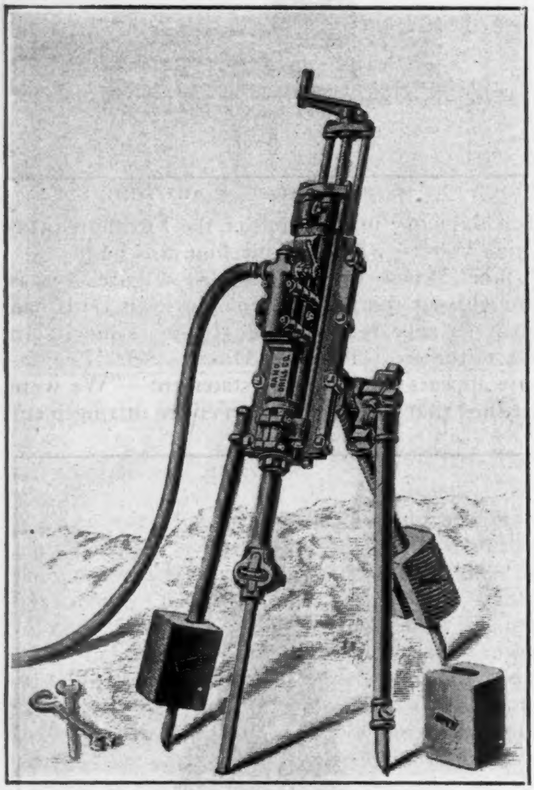


FIG. 10. THE RAND LITTLE GIANT.

bar mounting in place of a carriage mounting. came next. It was employed in the Musconetcong Tunnel of the Lehigh Valley Railroad. This was about the year 1871.

Figure 10 shows the Rand Little Giant Drill as developed by A. C. Rand and George Githens in 1875. This drill also employed a tappet action controlled by the motion of the piston to operate a flat slide valve, as shown by the cross-sectional view Figure 11. It was with this type of machine that the side rod construction made its appearance,

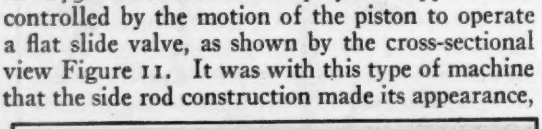


FIG. 11. CROSS SECTION OF THE RAND LITTLE GIANT

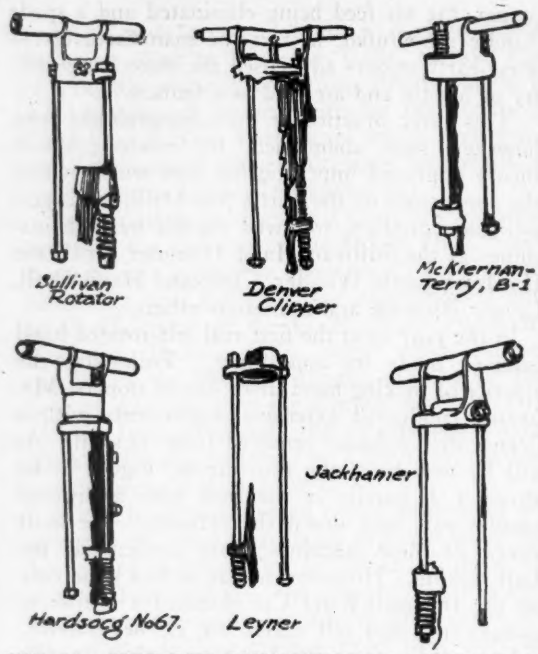


FIG. 12. SIDE ROD CONSTRUCTION OF MODERN DRILLS.

which is found even today in later drills, such as the present day Leyner-Ingersoll, the Sullivan Water Drill, the Sullivan Piston Drill, the Denver Dreadnaught and many others. See Figure12.

The Rand Little Giant Drill was largely adopted throughout the Lake Superior iron country as well as certain sections of the copper country. Some of its notable work is the Hell Gate Channel excavation and the Weehawken Tunnels.

Figure 13 shows the Ingersoll Eclipse Air Thrown Valve Drill, which was an improvement over the Ingersoll Drill invented by Henry C.

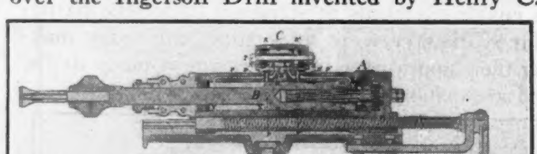


FIG. 13. INGERSOLL ECLIPSE DRILL WITH AIR THROWN VALVE.

Sergeant 1873 and brought to its final state of development in 1878. This was the first independent valve motion control. The Ingersoll Eclipse Drill was employed in driving such tunnels as the Cascade, Bozeman, Silverbow, Siskiyou, Snow Shoe, Vosburg, Coosa Mountain, Wickes and Croton Aqueduct.

Figure 14 shows the Slugger Rock Drill invented by Halsey and introduced by the Rand

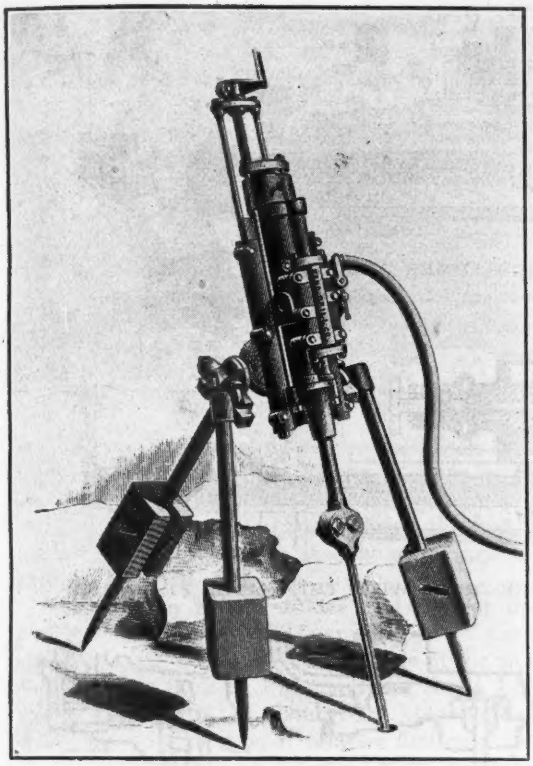


FIG. 14. THE RAND SLUGGER ROCK DRILL.

Drill Co., now the Ingersoll-Rand Company, in 1883.

This machine, it will be noted, is equipped with side rods and a flat back head spring to absorb shocks. The valve is of the piston or spool type. While having an independent valve action it was without variable stroke. It was largely used in mine work and in some of the big aqueduct tunnels.

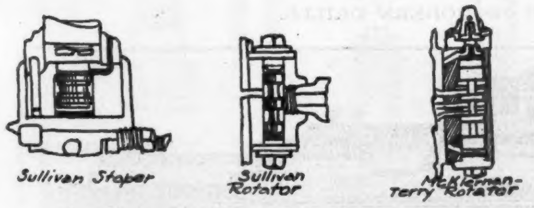


FIG. 15. MODERN VALVE ACTIONS OF THE PISTON OR SPOOL TYPE.

A great many of our modern day drills employ independent air thrown valve actions patterned largely after these two first types. Even the first Leyner Hammer Drill borrowed the spool valve from these early constructions. Figure 15 shows the valve action of a number of various makers' drills of today which fall under the same classification.

In 1884 the Sergeant Auxiliary Valve Drill came to the front, bringing with it the release rotation and a spool valve motion controlled by a crescent shaped piece in contact with the main piston, as shown in Figure 16.

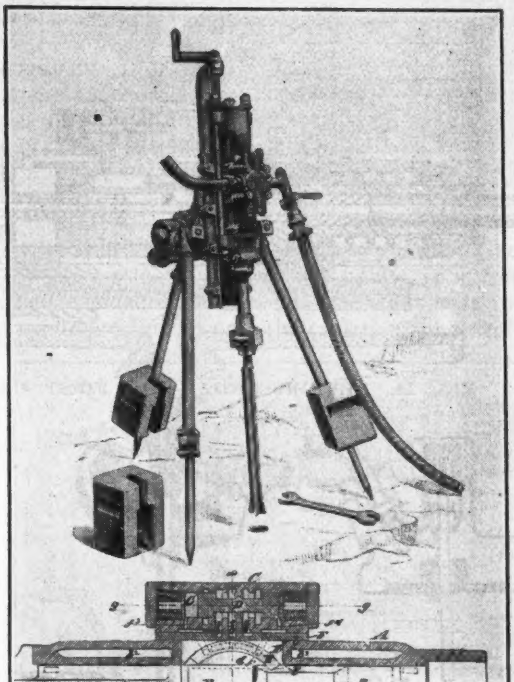


FIG. 16. THE SERGEANT ROCK DRILL.

This type of drill largely replaced the Little Giant in the Lake Superior mines and drove the Catskill Aqueduct Tunnels and many others, among them the Pennsylvania Tunnel under the East River, New York.

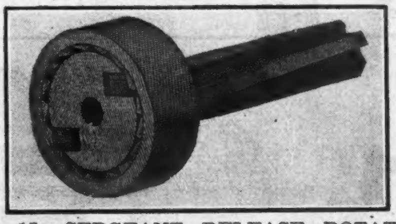


FIG. 17. SERGEANT RELEASE ROTATION.

The release rotation feature of this type of drill shown in Figure 17, gradually found its way into other makes of drills including the No. 6 Water Leyner Drill brought out by Leyner in 1908.

Starting about 1898 up to the present time we pass through a revolution in the mechanics of the rock drill. This is the period of hammer drills

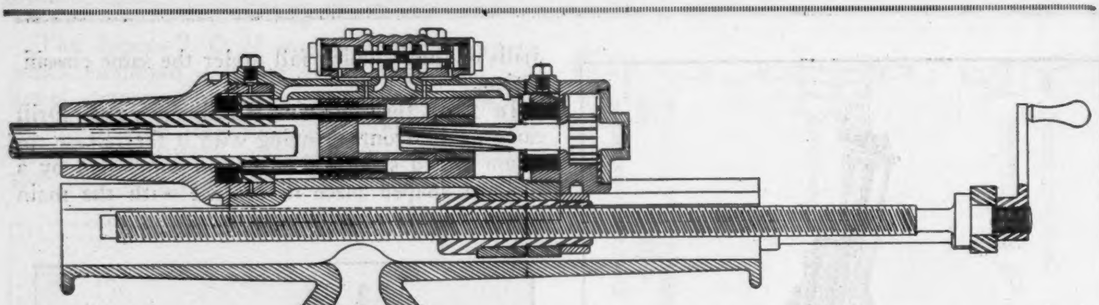


FIG. 18. LEYNER'S FIRST HAMMER DRILL.

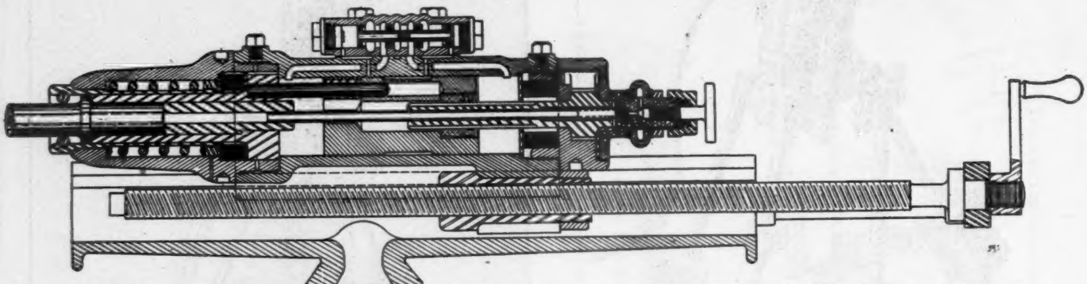


FIG. 19. LEYNER DRILL—THE FIRST HAMMER DRILL WITH THE WATER FEATURE.

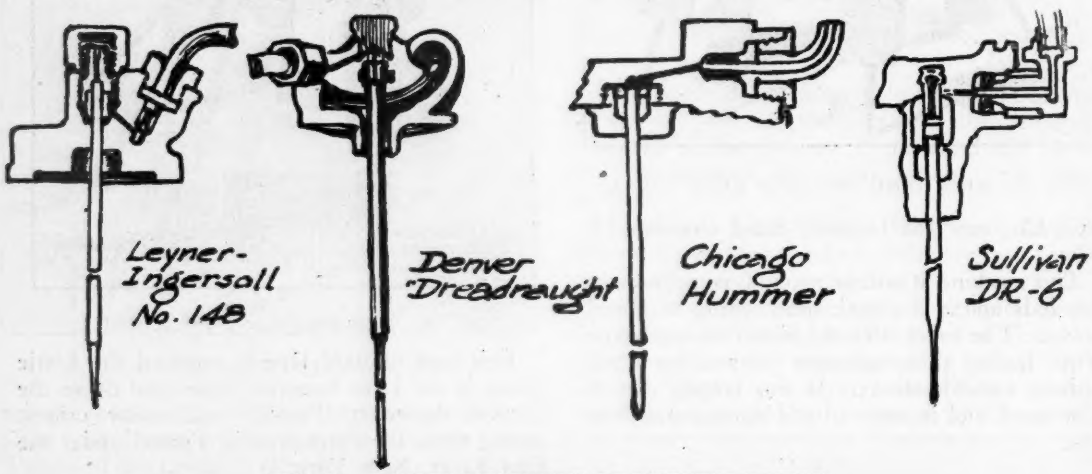


FIG. 20. WATER FEATURES OF MODERN DRILLS.

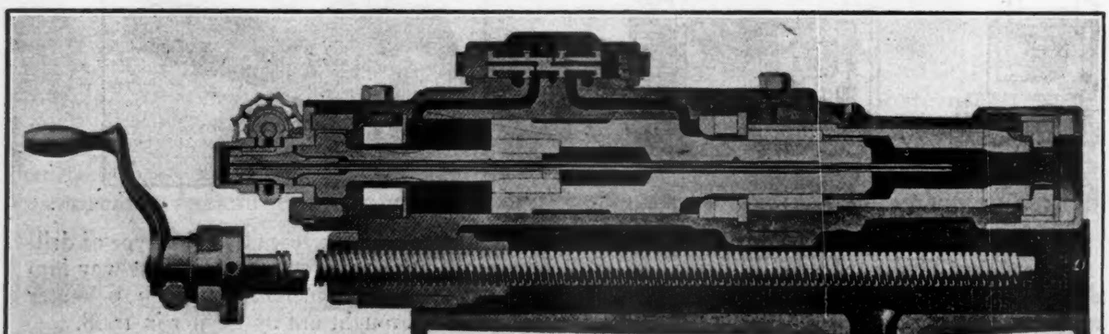


FIG. 21. No. 5 WATER LEYNER DRILL.

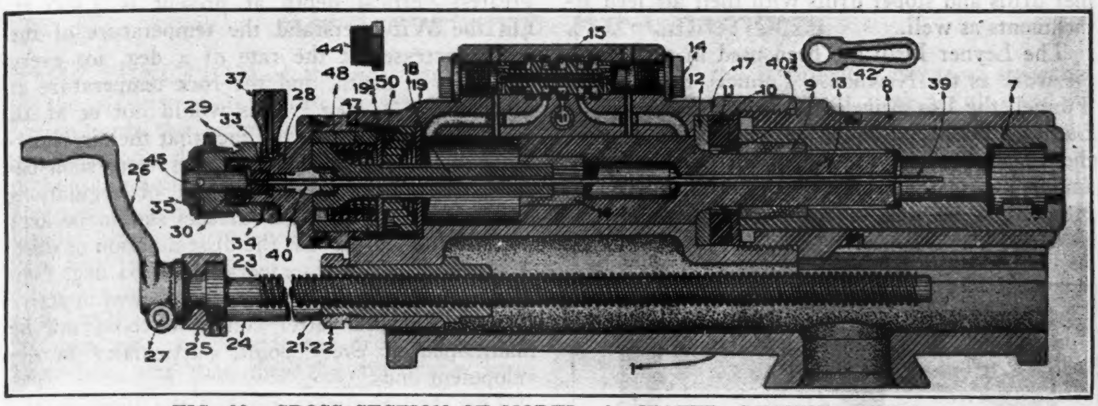


FIG. 22. CROSS SECTION OF MODEL 6. WATER LEYNER DRILL.

and we see the gradual passing of the piston drill. Leyner's drill as shown in Figure 18 made its appearance in 1897, followed by the type of drill shown in Figure 19, in 1898, it being the first of his or anv other drill to employ water and air through the drill steel.

Referring to Figure 20 we find present day builders of hammer drills borrowing in its essential details the water and air principle of the Leyner Drill. Figure 21 illustrates the No. 5 Leyner Drill brought out about 1903, showing substantially the same type of rotation first employed in the later models of Leyner Drills, excepting that it had a locking key for holding the steel in the chuck, which feature was abandoned in the Model 6, Figure 22, already referred to, and later types.

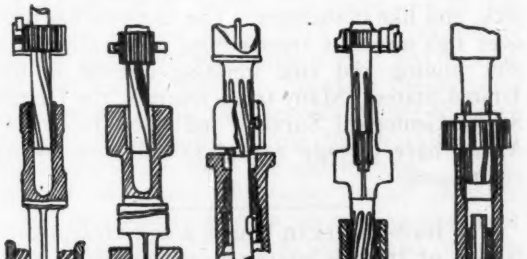


FIG. 23. HAMMER ROTATIONS OF MODERN DRILLS.

Figure 23 shows the rotations of various makes of hammer drills, which it will be noted correspond in main essentials to the Leyner type. In Figure 24 is shown the No. 7 Leyner Drill, which may be said to be the real father of all present day hammer drills. It includes in its design the Sergeant release rotation feature, the rifle bar rotating sleeve chuck feature, the water and air feature, and the first automatic lubricator, as well as enclosed-in-the-machine throttle construction, and one piece solid front head and finally, split front head with through bolt retained front head cap. It is interesting to note the variations of features

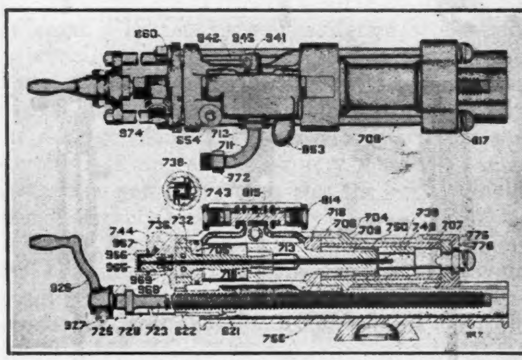


FIG. 24. CROSS SECTION NO. 7 WATER LEYNER DRILL, MODEL 6.

of these designs as found in other makes of machines, as shown in Figure 25, including the mounted hammer drills, self-rotating hand ham-

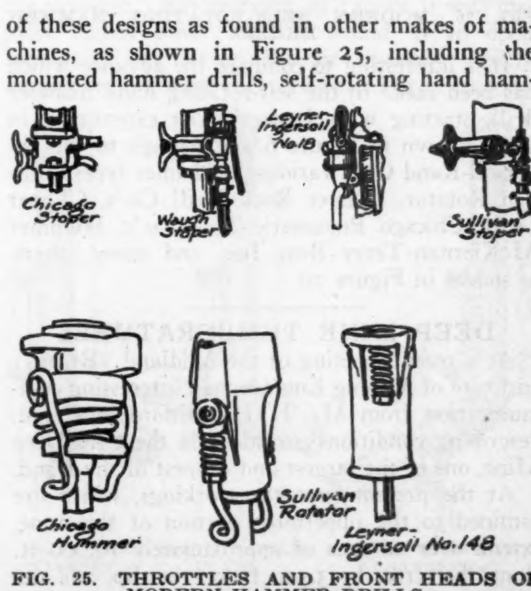


FIG. 25. THROTTLES AND FRONT HEADS OF MODERN HAMMER DRILLS.

mer drills and stoper drills with their air feed attachments as well.

The Leyner Drill has been used in such notable work as the Newhouse Tunnels, the Lucania Tunnel, the Los Angeles Aqueduct Tunnels, the Laramie Poudre Tunnel, as well as in some of the biggest mines of the country, numbering among others the Calumet & Hecla, Anaconda, Homestake, as well as many other large mines abroad.

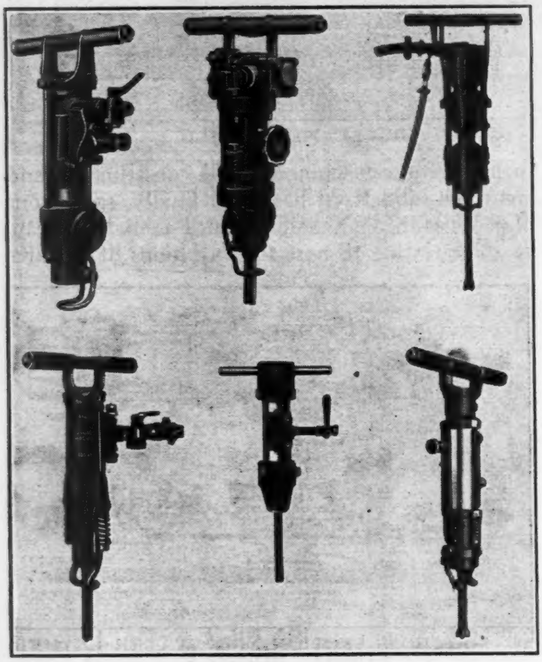


FIG. 26. MODERN SELF-ROTATING HAMMER DRILLS.

It is interesting to compare the advance which has been made in the self-rotating hand hammer drill, starting with Leyner's first experiment in 1909, shown in Figure 6, on through to the Ingersoll-Rand Co.'s various Jackhamer types, Sulivan Rotator, Denver Rock Drill Co.'s, Clipper Drill, Chicago Pneumatic Tool Co.'s, Hummer McKiernan-Terry Busy Bee, and many others, as shown in Figure 26.

DEEP MINE TEMPERATURES

At a recent meeting of the Midland (British) Institute of Mining Engineers an interesting communication from Mr. E. H. Clifford was read, describing conditions prevalent in the City Deep Mine, one of the largest and deepest of the Rand.

At the present time the workings, which are confined to the uppermost portion of the mine, extend over an area of approximately 10,000 ft. along the strike by 3,500 ft. on the dip, and the greatest vertical depth at present is 4,500 ft. On the Witwatersrand the temperature of the rocks increases at the rate of 4 deg. for every 1,000 ft. in depth, and the rock temperature at 4,500 ft. is 84 deg. This would not be at all serious were it not for the fact that the air, shortly after leaving the main intakes, very soon becomes saturated in consequence of regulations stipulating that all rock surfaces should be kept wet in order to prevent the dissemination of dust. A saturated air at a temperature of 84 deg. Fah. is scarcely supportable unless the air was in active motion, and this latter condition could not be maintained at every point, particularly in development ends.

They had therefore reached the limit on the City Deep, and had yet an additional 2,500 ft. to go when the new shaft is completed, and were faced with the necessity of reducing the air temperature from between 95 and 100 deg. Fah.—which it would be at 7,000 ft.—to about 75 deg. Fah. The principle that was being relied upon was the heat-absorbing capacity of the ventilating current of air due to evaporation and to its specific heat. Local cooling near the bottom of downcast shafts was, of course, taking place everywhere, but it generally remained local cooling.

ZINC IS ZINC

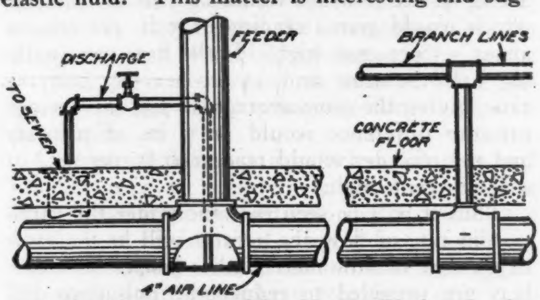
The American Zinc Institute recently formed, has, as one of its objects, to free zinc from its many nicknames, and is making an effort to discourage the use of such names as spelter, blende, jack, and like misnomers. The institute has now over 140 members representing practically every zinc mining and zinc smelting interest in the United States. Many trade journals, the United States Geological Survey, and the Bureau of Mines have already agreed to call zinc by its right name.

The Italo-American Union, a new trade organization of Italians interested in America, has recently come into existence. It is designed to furnish a centre for all Italo-American committees, and comprises economic intellectual, art, legislative, and press sections. The National Foreign Trade Council learns that behind it are the big financiers and commercial men of Italy, who hope to encourage the commercial and economic relations between the two countries.

The Association has obtained the beautiful mediaeval Palazzo Salviati on the Corso Umberto, and will provide there an information office for American business men, a library of American industry, and a central meeting place combining both business and social features.

Air for Pump Air-Chambers

THE FUNCTION of the air chamber and the necessity of its operative pressure in connection with the reciprocating water pump to ease the shocks due to the starting and stopping of the column of water in the pipe line with each stroke is so generally recognized that a pump without this appurtenance is a rare anomaly. Providing the air chamber, however, is not providing the air which should be operative within it, and at this late day it is being realized that air chambers will not provide the necessary air for themselves, and that they too frequently have little or no air when they should be and are assumed to be full or nearly full of the necessary elastic fluid. This matter is interesting and suggestively discussed by Mr. H. D. Fischer in the article which we here reproduce from the issue of *Power* for Aug. 5, 1919.



The function of an air chamber is to provide an elastic cushion to absorb the energy of the column of water leaving the pump, which has attained a velocity higher than the average during the middle of the piston stroke, and to feed out this energy again to maintain the velocity of the water in the pipe beyond the air chamber more nearly uniform during the period at the end of the stroke when the piston stops. To accomplish this most effectively, the air chamber should be arranged so that the moving stream of water flows directly into its lower end or is so guided into it that little energy will be lost by the eddying and disturbed flow of water making a sharp, unguided turn or attempting to return upon itself. It must not be lost sight of that it it is just as much the function of the air chamber to feed out the energy absorbed and thus maintain a reasonably uniform flow as it is to absorb the shock in the first place. A water gage should always be installed so that it is known there is air in the air chamber.

The illustrations show arrangements suitable to various locations, all of which will work satisfactorily, as has been proved in many installations. Of these, Fig. 1, where a riser turns into a horizontal run is probably the most desirable as it requires fewest fittings, these are all standard and in it the air column meets the flow most directly. Equally effective is that shown in Fig. 2, for use in horizontal runs. Many similar air chambers have been condemned because the baffle to direct the stream upward has been omitted. The baffle need not fit water tight, but should fit reasonably close and be firmly fastened by welding or screwed clips, as in long lines the pressure against it is considerable.

Arrangements shown in Figs. 3 and 4, where a horizontal line turns sideways or downward, are also good, but that shown in Fig. 5 should not be installed except where there is a supply of compressed air available for filling.

The best results are obtained by making the air chamber of the same size pipe as the feed line and obtaining the necessary volume by increasing its length. If it is made either larger or smaller, there will be an abrupt change of velocity in the water entering or leaving the air chamber, with a corresponding loss of energy and efficiency. For the average plant the dimensions shown on the sketches are ample, but for very long lines, such as occur in pumping plants, etc., the height should be considerably increased.

But no matter how well located the air chamber is, it must contain sufficient air to provide a cushion, and in plants where no supply of compressed air at or above boiler pressure is available this is often difficult to maintain, as the solvent power of water for air increases directly with the pressure. For instance, at 150 lb. it will dissolve eleven times what it would in an open tank, and any air in the air chamber rapidly disappears. Under such conditions it is custom-

FIG. 1. AIR CHAMBER

FIG. 2. BAFFLE IN TEE

FIG. 3. ANOTHER ARRANGEMENT

ary to use the feed pump as a compressor, where the suction pressure is not too high, opening the water-cylinder drain-cock on the suction stroke, or with an open heater lowering the water level during a light-load period so that the pump sucks some air.

A slightly more elaborate but effective arrange-

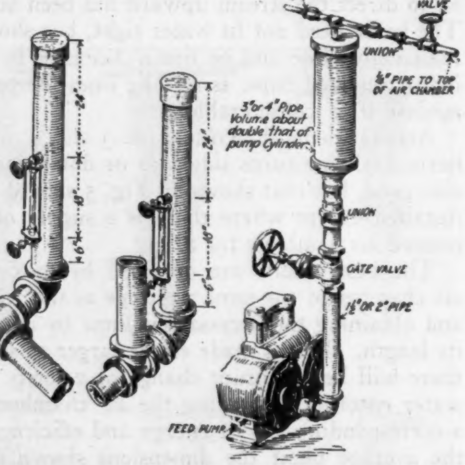


FIG. 4. A GOOD ARRANGEMENT FIG. 5. REQUIRES COMPRESSED AIR FIG. 6. HOW AIR IS SUPPLIED

ment, devised by Mr. Merriam, master mechanic at the Methuen Co., Methuen, Mass., is shown in Fig. 6. This also has the advantage that by throttling the valve it can be arranged to deliver just the quantity of air required and will work indefinitely without attention. By means of the unions it could be quickly removed for the purpose of making repairs to the pump or for packing pistons.

It is only very long lines, where the weight of the moving column of water is such as to cause severe shocks, or where pumps are in very bad condition and give a similar effect, due to reversed blow, that the need of air chambers is forcibly impressed on the operating engineers. They are, however, advisable under all circumstances and particularly where it is desired to measure flow by means of orifice, venturi or pitot-tube meters, as, by reason of the natural laws on which they work, pulsating flow will cause all of them to read high by varying amounts.

In all these meters the pressure difference which operates the recorder mechanism is proportional to the square of the rate of flow; that is, if the flow is doubled, the pressure difference operating the recorder increases four times. Owing to inertia of the meter mechanism and friction and inertia of the water in the recorder connecting pipes, the water acts like a throttled gage and shows a fairly steady reading, this reading corresponding to the average of all the differences of pressure corresponding to the flow at each instant.

But in a situation of this kind the higher rates of flow will have a great deal more than their proper share of influence on the averages, as what is being averaged is not the flows, but the pressure difference produced by them, which increases very much faster than the rate of flow. For example, if for half the time the flow were 5 ft. per sec., producing a pressure difference of 2 in. of mercury, and half the time 10 ft. per sec. with a pressure difference of 8 in. of mercury, then the average flow during the period would be 7.5 ft. per sec., but the average pressure difference acting on the recorder would be 5 in. of mercury, which would give a reading of 5 ft. per sec., or about 5.5 per cent. high. If the flow were nothing half the time and 15 ft. per sec. half the time, giving the same average of 7.5, the average pressure difference would be 9 in. of mercury and the recorder would read 10.6 ft. per sec., or 41.4 per cent. high.

Thus it will be seen that the wider the variation in rate of flow the greater will be the error of the rate of flow meter unless proper air chambers are provided to reduce the pulsations and produce a reasonably steady flow.

Reducing the fluctuations in flow by means of an air chamber is the only correct solution for problems of this kind. While experiments could be made and the meters calibrated to correspond to the conditions found, yet if the load, or particularly the condition of the pump and valves, changed, so that, for example, there was a slightly reversed flow, due to a defective valve on one pump stroke, this effect and its correction, which may very properly be called its pulsation factor, would be entirely different and require recalibration of the meter, while if proper air chambers are installed and it is seen that these are kept filled with air, the original meter calibration may be relied on and may be checked against steady flow at any time.

The following concise and pithy expressions appeared in *Power* recently and are well worth being passed along: Adaptability means doing the next best thing in the handiest way. Efficiency is knowing just how and fitting it to just when. Loyalty consists in being decently considerate of the boss. Responsibility lies in having grit enough to risk a call down. Opportunity is the same thing as being born lucky. Reliability shows the capacity for staying put longest. Integrity is the Sunday name for plain weekday honesty.

Vitiation of Garage Air and Its Dangers*

AMONG THE investigations conducted by Bureau of Mines there have been several relating to the dangers attending the use of gasoline for fuel and other purposes. Among these dangers is that of the vitation of the air in inclosed places, such as mines or automobile garages, by the carbon monoxide in the exhaust gases of an internal combustion engine burning gasoline.

The occurrence of a number of accidents, some of them fatal, whereby people have been overcome through breathing air fouled by the exhaust gases from automobile engines, discloses a hazard that is more serious than it is generally thought to be. Automobile engines frequently run in garages for considerable periods of time, and the exhaust gases, unless removed by proper ventilation, may make the atmosphere of the garage unsafe. Running an engine in a garage is particularly hazardous in winter when the weather is too cold for keeping doors and windows open.

Carbon monoxide is a colorless, odorless and tasteless gas. It is extremely poisonous, because it combines with the red coloring matter of the blood more readily than oxygen does, and blood that is saturated with it can not take up oxygen. Exposure to an atmosphere containing only 0.20 per cent will cause a man at rest to collapse within an hour, and exposure to as little as 0.05 per cent causes headache in several hours' time. Different people are affected differently, and a man at work will be overcome much more rapidly than a man at rest. The dangerous symptoms come almost without warning, and collapse in a garage would prove fatal unless outside aid arrived very soon, because the running engine would continue to generate carbon monoxide and continue to make the air more poisonous. One of the authors of this paper was extremely ill for eight hours after exposure for 20 minutes to air containing 0.25 per cent of carbon monoxide.

When a person is found overcome in a garage throw the doors wide open and remove the person to fresh air at once. If a tank of oxygen and a breathing mask are at hand and the person is breathing, administer oxygen through the mask for 20 minutes. If the person is not breathing, give artificial respiration by the prone pressure or Shaefer method. Do not delay. Do not wait for the doctor or for artificial respiration apparatus. Begin at once.

Lay the victim on his belly with his face to one side, so that his nose and mouth are free for breathing. Place one of the victim's arms and hands straight out beyond his head, the other under his head. This position helps to expand his lungs.

Kneel, straddling the victim's thighs and facing his head; rest the palms of your hands on his loins (on the muscles of the small of his back), with your thumbs nearly touching each other and with fingers spread over his lowest ribs.

With arms held straight, swing forward slowly, so that the weight of your body is gradually, but *not violently,* brought to bear upon the victim. This act should take about two seconds.

Then, leaving your hands in place, swing backward slowly, so as to remove the pressure, thus returning for two seconds to the first position.

Repeat deliberately 16 to 20 times a minute the swinging backward and forward—a complete respiration in about four seconds. Keep the movements in time with your own breathing.

While the artificial respiration is being continued, have an assistant draw forward the victim's tongue, if it has fallen back (fortunately it usually falls forward when the victim is face down). Hold the tongue out, if it tends to draw back, by wrapping a handkerchief around it. The handkerchief may also protect the assistant's fingers from being bitten. The assistant should also loosen any tight clothing around the victim's neck, chest, or waist.

Do not permit bystanders to crowd about and shut off fresh air. Keep the victim warm with proper coverings and by placing beside his body hot bricks, bottles, or rubber bags filled with warm (not hot) water. Wrap bricks, bottles, or bags so as to prevent burning the victim.

Continue the artificial respiration *without interruption* until natural breathing is restored, or for at least three hours. If natural breathing stops after being restored, use artificial respiration again.

Do not give any liquid by mouth until the victim is fully conscious. Keep the victim flat. If after being partly resuscitated he must be moved, carry him on a stretcher. It is dangerous to make an ill person sit up or stand. To make him walk may cause death.

When gasoline is burned in the presence of enough air, the carbon is almost entirely converted into carbon dioxide and the hydrogen into water. If, however, the amount of air is not enough, besides carbon dioxide and water, carbon monoxide, hydrogen, and methane are formed. As these three gases are all combustible when mixed with air, their presence in the exhaust represents waste. Hence the presence of large amounts of carbon monoxide in the exhaust is to

*Abstract from Bureau of Mines Technical Paper 216, by G. A. Burrell and A. W. Gauger.

be deprecated as regards both efficiency and safety. The carbon dioxide is at its maximum when 2.5 per cent of gasoline vapor is contained in the mixture prior to combustion. From that point the carbon dioxide decreases and the carbon monoxide begins, the latter reaching a maximum at 4.1 per cent of gasoline vapor. The range of complete combustion is very narrow, between 1.5 and 2.5 per cent, so that it is almost impossible to run an engine without producing carbon monoxide at times. Watson has shown that carbon monoxide begins to form with mixtures of 14 parts air by weight to 1 part of gasoline, and increases to about 12 per cent at 9 parts air to 1 of gasoline.

THE INDICATOR CORRECTS THE COMPRESSOR

The indicator diagrams here reproduced suggest at once how mistaken may be our comfortable assumption of air compressor efficiency in any individual case and pointedly call attention to the importance and value of indicator revelations. The diagrams were contributed to a recent issue of *Power* by Mr. R. McLaren, Toronto, Ontario, and his narrative follows:

While watching the valve gear of a 33x36-in. air compressor perform recently, the inlet valve at one end appeared to be closing late. Turning the engine over by hand slowly, I found that the piston had traveled one inch when the valve closed. The compressor is equipped with an inlet valve the opening of which is effected by a cam and the release by a separate eccentric. The discharge valves are of the poppet type, and the machine ran 54 r.p.m. at the time.

The loss of one inch of the stroke meant a loss of 26.7 cu. ft. of air per minute. That in itself was worth saving, but suspecting that the effect of inertia on the closing would make the loss more serious, I rigged up an indicator connection and got diagram, Fig. 1, which showed that before closure was complete the piston had traveled 6½ in. This indicated a loss of 173.6 cu. ft. per minute, or 18 per cent. for one end. Advancing the closing eccentric resulted in the diagram, Fig. 2.

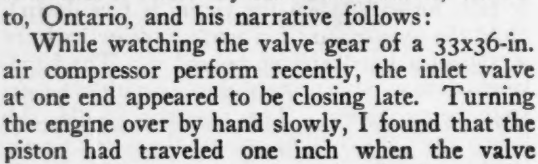


FIG. 1. FIG. 2.

This compressor is one of a pair driven by two engines connected to a common shaft with the cranks set at 90 degrees. The unloaders were set to operate one end of each compressor at the time, the unloading being abrupt and complete and the valve remaining open during the unloaded period. The governor was equipped with an oil dashpot.

When I took charge of the plant, the governor was out of commission, the engines running on the throttles; the unloaders were also out of service. After getting the governor fixed, I foolishly filled the pot with cylinder oil, thinking that would give better results in regulating. Not so, however. At every operation of the unloader the speed would increase until the governor would get control of the situation, and perhaps by that time the unloader would be ready to dump the load on again, when the speed would go in the opposite direction.

I exchanged the cylinder oil for engine oil. There may have been some improvement, but I couldn't notice it. In desperation I disconnected the dashpot from the governor with the result that the regulation is about as even as one could wish it to be, but the governor is a busy one.

FOR DRAINING COMPRESSED AIR MAINS

The drawing off of the water which accumulates in air mains that have a long horizontal run should always be provided for, and advantage should be taken of low points where the water will collect, or pockets or enlargements of the pipe may be provided for the purpose. It is always well to remember, however, that while the depressions within the pipe are necessary for drawnig off the water, such depressions are not needed outside the pipe for the water to run off, as the air pressure can be taken advantage of to deliver the water almost anywhere.

E. C. Pratt shows in *Power Plant Engineering,* by the sketch here reproduced, and which explains itself, how he rigged up to get rid of the water. The ½ in. water line discharging into the sewer was brought to within a small fraction of an inch of the bottom of the main, and the valve could be opened occasionally to draw off the water.

In the 106 years between 1807 and 1913, and including those years, American mines produced a total of 9,844,159,937 tons of coal. In the succeeding five years the mines turned out 2,960,938,597 tons of coal, almost one-third as much as was mined in the entire 1807-1913 period, and almost one-fourth of all the coal mined in the United States since records have been kept.

A writer in *Railway Age* cites figures of record showing that it cost a certain big railroad $21,849 to scientifically ascertain and determine that it costs one-tenth of one cent to drive a track spike.

Utility Street Railway Trucks

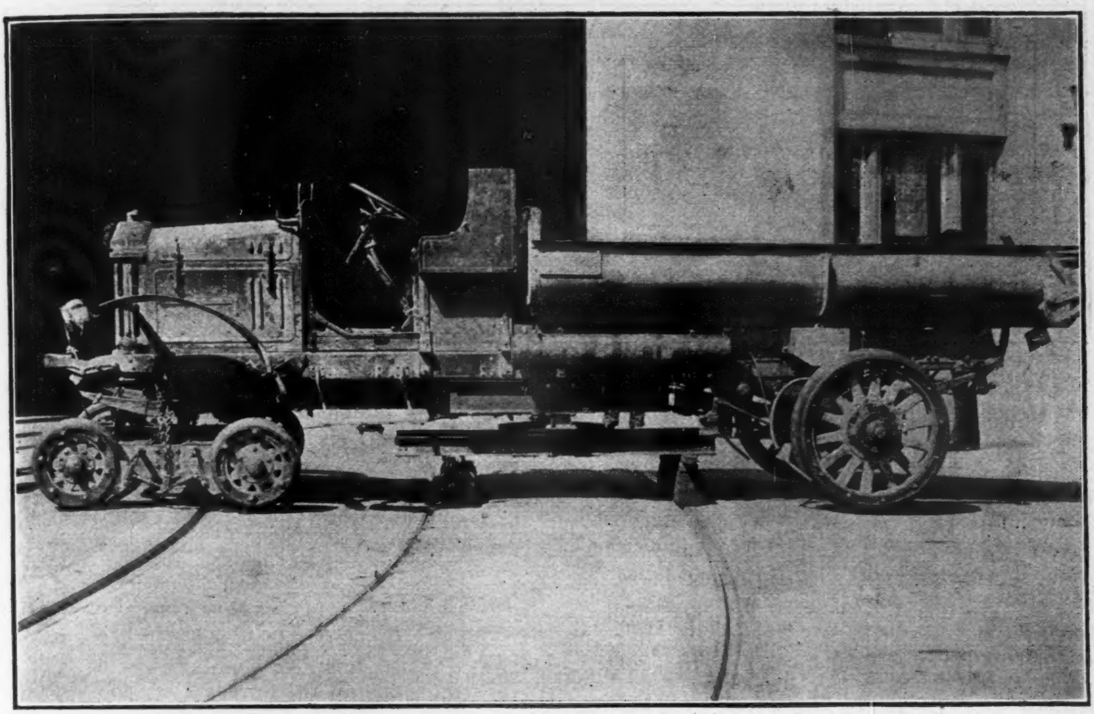


FIG. 1—UTILITY COMPRESSED AIR TRUCK

The two photos here reproduced show samples of a fleet of motor trucks which have been equipped with flanged wheels and are operated on the Hetch Hetchy railroad by the City of San Francisco. They are variously equipped or can be readily changed according to the service required.

FIG. 2—TRUCK FOR FREIGHT OR PASSENGERS

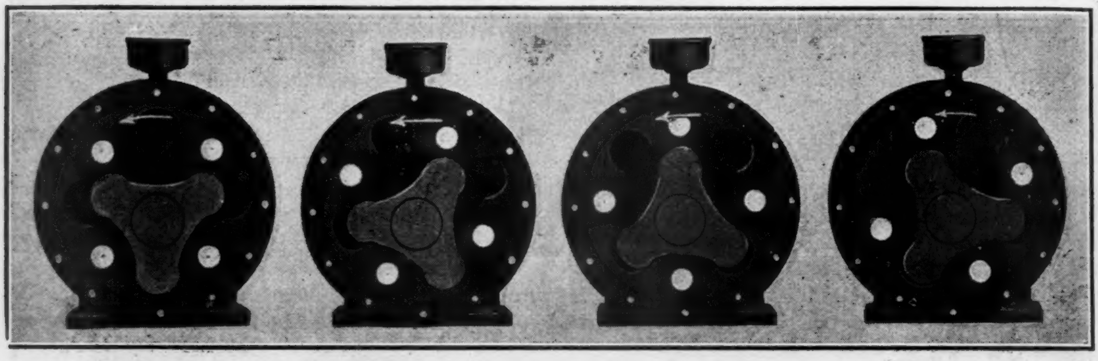
Fig. 1 is equipped with air sanders operated from an 8 in. by 35 in. horizontal air reservoir seen in the middle of the machine and charged by a four cylinder Kellogg pump installed inside the engine hood.

This truck has a dumping body, and under the center of it is permanently carried a turntable which is clearly shown. When it is necessary to turn the truck or to lift it off the rails the turntable is jacked up—or rather down—until the truck wheels are clear, and then the machine can be reversed or otherwise turned as desired. Fig. 2 shows another of the trucks rigged for hauling express or for carrying gangs of men to their work.

Because of the law prohibiting the employment of boys in the anthracite mines of Pennsylvania, the operating companies are employing old men in their places, as slate pickers, jig operators, chute tenders and oilers in the breakers.

There are nearly 35,000 fewer horses in service in New York City than there were two years ago, a reduction of more than 30 per cent.

An Ingenious Rotary Pump or Blower



THE INTERESTING pump or blower here shown was exhibited at the annual show of the Royal Agricultural Society of England by Fielding & Platt, Limited, Gloucester. The pump is the invention of Mr. E. Fenerheerd, Bath, and for the illustration we are indebted to *The Engineer*, London. The four rotative positions shown leave little call for additional explanation. The four pocketed ring which fits easily in the circular case, and the rotating triangular impeller are enclosed within the plates which form the covers of the case. It will be noticed that the driving shaft which carries the impeller is located below the center of the case. The inlet and discharge openings are located in either or both of the covers, extending but little above the center line. With the rotation as indicated by the arrows the discharge would be on the left side and the intake on the right.

As there are no valves or other parts to wear or get out of order this should be a very satisfactory pump for water and a quite effective blower, but it could not be expected to be so successful as a high pressure air compressor.

A COMPRESSED AIR JET AS A FIRE SCREEN

A German technical paper treats of methods employed for screening furnaces. Workers who have frequently examined what is going on in the intensely heated and glowing masses suffer much from the heat radiated and various devices have been tried for relief. Hollow, water cooled furnace doors afford protection only when closed. Devices have been installed for drawing off the hot air in front of furnaces by centrifugal exhausters, the objection to these being that the workers are subjected to too great and sudden changes of temperature. The most effective arrangement is to fix immediately behind the furnace door a narrow, oblong nozzle through which cold air is blown upward, thus interposing a screen of relatively cool air between door and furnace. This arrangement is to give adequate protection to the worker, and has the incidental advantage that when the doors of the furnace are opened the escape of flame is checked.

TERMINAL IMPROVEMENTS FOR JAMAICA BAY

We read in recent announcements that Alton H. Greeley, one of the principal warehouse owners in Cleveland, who is also connected with the controlling interests of the Baltimore & Ohio Railroad Company, is to head a new $100,000,000 syndicate which will construct warehouses and piers on Jamaica Bay. In view of the fact that the Baltimore & Ohio Railroad is affiliated with the Pennsylvania Railroad it is considered probable that a freight tunnel may be constructed under the Narrows from Bay Ridge to Staten Island, there connecting with the main lines of the companies crossing the state of New Jersey.

Dock Commissioner Hulbert was directed this autumn to prepare a bill covering dredging in Jamaica Bay. The bill will be submitted to Congress after it has the approval of the Sinking Fund Commission. The bill provides for a main channel 1,500 feet wide and 30 feet deep, and an interior channel 1,000 feet wide and 30 feet deep.

The Co-Operative Mining Company of Lordsburg, New Mexico, in straightening its shaft on its property fifteen miles north of that place, encountered a body of native silver ore five feet from the surface. The lode is seven feet in width and assays show values of from $1,200 to $1,500 to the ton.

Compressed Air on San Francisco Docks

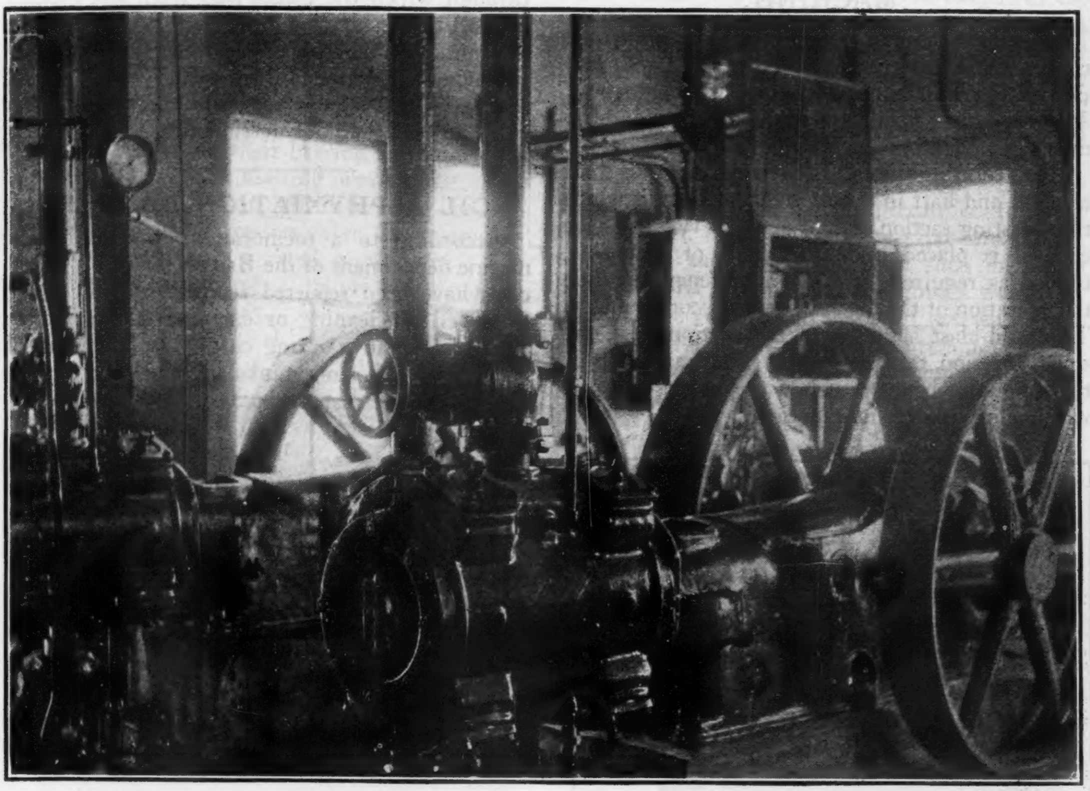


FIG. 1—THE COMPRESSOR INSTALLATION

The two photos here reproduced have to do with a novel use of compressed air. Fig. 1 shows two single-stage belt driven Ingersoll-Rand air compressors installed by the W. R. Grace Company on their docks at San Francisco, and Fig. 2 is a close-up view of piping and valves at the edge of the pier. The installation is initially employed for the handling of cargoes of cocoanut oil. Cocoanut oil, by the way, is not always oil, but solidifies like lard when it becomes cold. It comes from the Orient in large tanks built into the ships, and in order to pump the oil out it must be heated by steam coils.

When the vessel ties up connection is made from the tanks on the ship to the pipe system leading to the storage tanks on shore, and powerful pumps quickly drive the oil ashore. As soon as the oil is all expelled from the tanks compressed air is turned into the pipes which clears them of the oil remaining. This is done immediately, for if the oil were permitted to cool and harden it would be necessary to take the pipes apart to clean them. Another firm formerly pumped water into their pipes to clear them, but after seeing the success of W. R. Grace & Company they also installed a compressor. The air from these compressors is used also to drive the boiler feed pumps, and is also supplied to several piers in the vicinity to be used by different ship owners for repairing, hoisting and other purposes.

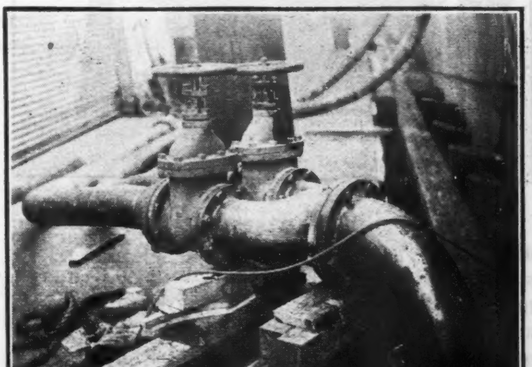
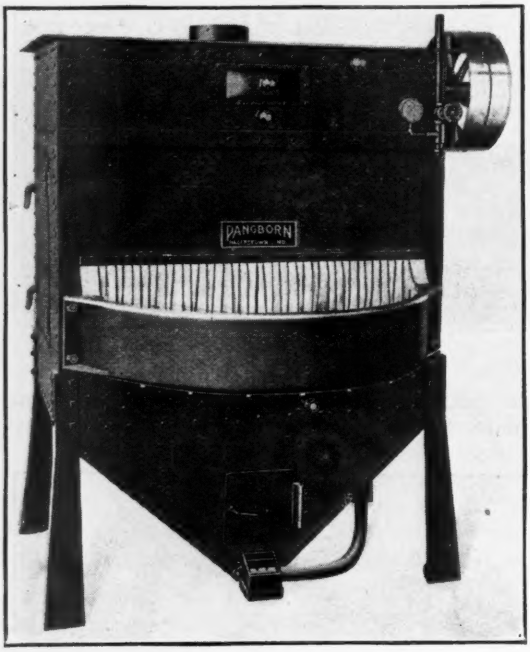


FIG. 2—PIPING ON THE PIER

NEW ROTARY TABLE SAND-BLAST MACHINE

We show here an improved sand-blast machine of the rotating table type, the latest output of the Pangborn Corporation, Hagerstown, Md., and first exhibited at the recent Foundrymen's Convention.

The rotating table, as will be seen, is half exposed and half in a dust tight heating in which the blasting action takes place. Work to be cleaned is placed upon the front of the table, turned as required, removed and renewed while the operation of the machine goes on continuously. The sand-blast action is of the suction type, the spent abrasion falling through the grated top of the table and being returned to the blasting service again without interruption.



The blast projector takes nozzles interchangeably from 1/8 in. to 5/16 in. and at 80 lb. pressure. The air consumption with the smaller nozzle is as low as 21 cu. ft. of free air per min. and the entire power for driving the table is little over 1 h. p. The machine is thus adaptable to the smaller shop as also an admirable auxiliary for special uses with larger equipment.

The table top is 42 in. diameter with a 4 in. high guard which serves as a retainer for small work, which otherwise might be dislodged or blown off by the blast; and with a 10 in. vertical opening for the passing of the work in and out of the blasting zone it is available also for pieces of considerable size and weight. The opening through which the pieces pass from the exposed portion to the blasting zone is closed by multiple pendant flexible rubber curtains which retain the flying abrasive and dust, making it a hygienic machine and available for installation with other machine tools without detriment.

OIL ASPHYXIATION DANGERS

According to a memorandum issued by the marine department of the British Board of Trade, cases have been reported recently in which men employed in cleaning or carrying out repairs in oil tanks, or in working cargo in holds situated above double-bottom tanks in which fuel oil is carried, have been asphyxiated or poisoned by the fumes or gases given off from the oil or cargo. To guard against such accidents, the Board of Trade has issued the following recommendations:

When fuel oil is carried, whether in double bottoms or elsewhere, care should be exercised that the tanks containing the oil are thoroughly oil-tight. The utmost care should be taken to ventilate thoroughly all spaces in which oil has been carried, as well as any adjacent spaces in which vapor may have accumulated, before men are allowed to enter such spaces. Thorough ventilation is necessary in all cases.

THE DANGER OF EMPTINESS

Two fatal accidents due to the explosion of so-called empty drums which had contained petroteum were reported to the Government (British) Inspectors of Explosives during the past year. In one case the drum had but recently been emptied, but in the other steps had been taken to remove all trace of petroleum by thoroughly washing out and rinsing the drum. The victim of the explosion, an experienced chemist, then put a light to the bunghole, either to prove that no inflammable vapour remained or to burn out the residue, and a violent explosion followed. This accident is one more indication of the difficulty of rendering safe a vessel which has contained petroleum spirit, owing to the density of the vapour, which is about two and a half times as heavy as air, and to the very small proportion of vapor required to make an explosive mixture with air.

Rubber is one of the few commodities which has not advanced in price since the war began. The average New York wholesale price for Para Upriver fine grade in 1913 was about 92c. per lb. In July, 1919, the price was 55c.

DOUBLE SUCCESS OF AN AIR REHEATER

The Spicer Manufacturing Company, operating a thoroughly up-to-date factory at Plainfield, N. J., quite naturally use considerable compressed air, the most voluminous call for which being for the oil burners of their heating and annealing furnaces, and for sand blasting operations.

Their air compressor, an Ingersoll-Rand superial Type X P V, piston valve, steam-engine-driven machine, with a rated capacity of 1,150 cu. ft. of free air per min., compressed to 50 lb., was installed late in 1915. As usual, the demand for air soon increased, so that as far back as July,

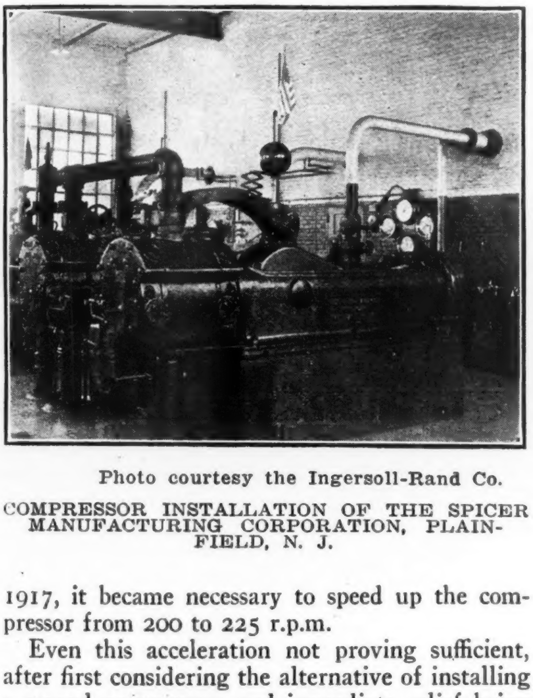


Photo courtesy the Ingersoll-Rand Co.

COMPRESSOR INSTALLATION OF THE SPICER MANUFACTURING CORPORATION, PLAINFIELD, N. J.

1917, it became necessary to speed up the compressor from 200 to 225 r.p.m.

Even this acceleration not proving sufficient, after first considering the alternative of installing a second compressor, and immediate relief being imperative, it was decided to place a reheater on the sand blast line and thus increase the volume of air delivered enough to carry over the peak. It was considered at the same time that with this temporary relief it would be possible in a comparatively short time to rearrange a portion of the oil furnace layout and thus reduce the air consumption in that department.

The reheater proved at once a complete solution of the problem of getting more air at a minimum cost and at the same time it eliminated another serious trouble in the sand blast room, the entire matter being clearly stated in the following extract from a letter of Mr. C. W. Spicer, Vice-President of the Spicer Manufacturing Corporation:

"From 50 to 75 per cent. of the output of the compressor is passed through the reheater. A very light coke fire, consuming about a bushel of coke in 24 hours so expands the air as to reduce the consumption by 25 per cent., and at the same time it eliminates the serious trouble caused by the moisture in both the air and the sand.

"Before installing the reheater we were compelled to take every possible precaution to avoid the moisture in the air, in the sand and on the surfaces of the work, and even then on damp days the sand would pack and things would all go wrong. With the reheater in use we do not need to think of the moisture question. No attention is paid to drying the sand before replenishing the supply in the machine, as the necessary quantity of new sand may be added more or less indiscriminately even though very damp, and the moisture will be absorbed by the warm sand already in the machine without any difficulty whatever. The forgings to be sand-blasted may be brought in from out of doors, not only wet but frequently in the winter carrying considerable snow, all without any trouble from the moisture.

"The expense and trouble of operating the reheater is infinitesimal as compared with the troubles which it completely eliminates. The upkeep on the reheater is practically nothing on account of the slow heat required."

CORRECTING A CONTINENTAL CLIMATE

It is proposed—and the proposition is regarded as not too chimerical for serious discussion—to construct a dike across the strait between Belle Island and the Newfoundland mainland. The purpose would be to turn the Labrador current out into the Atlantic and induce the warm Gulf Stream to flow into the Gulf of St. Lawrence. Although Newfoundland is as far south as England, its ports are ice-bound in winter because of this icy Labrador current which refrigerates the climate and shuts off the warm Gulf Stream which makes England so green. The proposed enterprise should, if successful, give eastern Canada a hot water system of heating its climate and make it like that of England.

F. V. Sargent has been appointed by the Chicago Pneumatic Tool Co. district manager of sales in the Boston territory, succeeding F. S. Eggleston, with headquarters at No. 182 High street, Boston.

In order to offset the war loses of 45 ships, aggregating 389,853 tons, the Cunard Line has build a total of 426,800.

OXY-ACETYLENE TORCH CUTS GRANITE

In repairing a drawbridge across the Passaic River, at Newark, N. J., it became necessary to remove a casting and pin from a granite pier. After several unsuccessful attempts to draw the pin, as narrated in Stone, the pin projecting down 3 inches into the masonry, it was found necessary to cut a trench in the hard granite so that the casting might be shifted laterally to one side for removal and replacement by a new and larger center casting. This trench was 4 ft. long, 9 in. wide and 3 in. deep, extending under the old casting. The cutting of the trench would have been an endless task had it not been discovered that an oxyacetylene flame chipped the granite ite readily and could be used under the old casting without damaging the balance of the masonry. The desired channel was thus quickly obtained. The flame was also used for cutting away the abutment back of the fixed span bottom chord to provide expansion clearance.

COMPRESSED AIR FOR DELIVERING SAND

The California State Board of Harbor Commission has recently completed a system of delivering sand to the locomotives of the Belt Railroad by means of compressed air. The sand is shoveled into the steel drum seen in Fig. 1 and is forced upward through the delivery pipe seen at the left, using air at a pressure of about 45 lb. The drum has a conical top slanting downward toward a large hole in the center which is closed

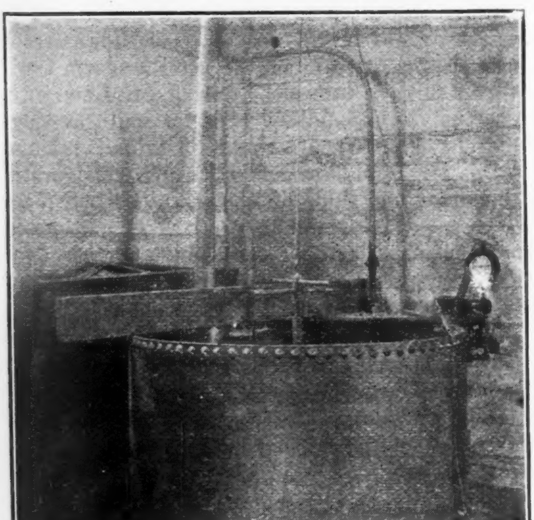


FIG. 1—THE PRESSURE DRUM

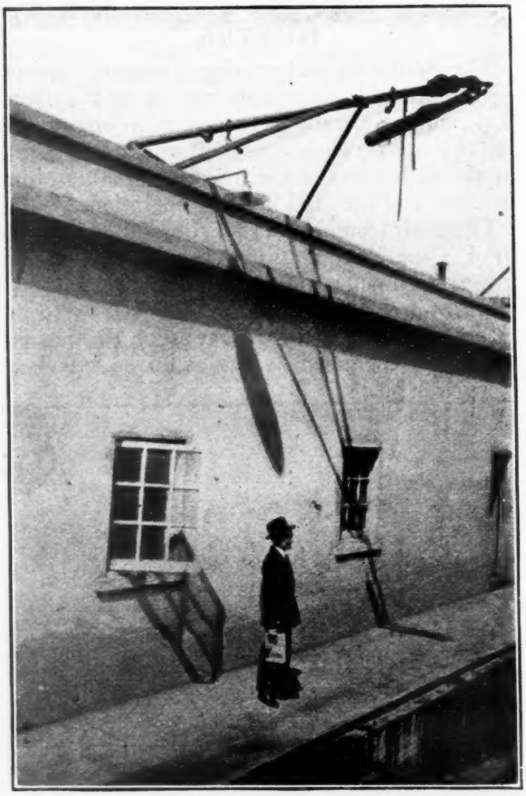


FIG. 2—THE DELIVERY PIPE

by a suitable valve or cover suspended from above by a rope. The sand is shoveled into the drum until it is nearly full when the cover is lowered into position and is clamped by turning the cross handles shown in the photo. Then the air is turned on and the sand is sent up through the roof of the building and is conveyed by the telescoped and jointed pipe seen in Fig. 2 for delivery to the locomotives as required.

In sinking a mine shaft at Kendall, Montana, through old heavy timbering the wood was cut very handily by using a wood chisel with a cutting edge 2 in. wide and operated by a Jackhamer drill arranged to work without rotation. This was used for cutting off logging, planks and ends of timber, which was accomplished rapidly and easily.

Chalk production of England is between 4,000,000 and 5,000,000 tons, with an approximate value of 10½ cents per ton. The output for 1913 was 4,458,126 tons, worth £213,479, of which 2,796,857 tons came from the county of Kent.

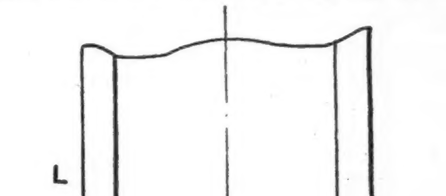
Air Pressure for Metal Casting

What follows is a small portion, in an abridged form, of an important paper by W. Rosenhain, F. R. S., and D. Hanson in the Transactions of the Institute of Metals.

During the last four years the Metallurgy Department of the National Physical Laboratory has been called upon to prepare a series of alloys of copper for certain special and most exacting requirements. Various alloys in a wide range of proportions were attempted to be produced and the most difficult and responsible operation was quite naturally the melting and the casting of the samples. Even when the greatest care was taken, and every precaution was taken to prevent the entrance of dross, it was found difficult to obtain ingots with satisfactory surfaces. The obvious remedy seemed to be to cast the metal by tapping it from a point well below the surface, and the most satisfactory method appeared to be the forcing of the liquid metal, by means of externally applied air pressure, through a feeder tube communicating with the bottom of the mold and dipping into the molten metal nearly to the bottom of the crucible.

In order to carry out this, it is necessary to use a previously heated feeder tube, through which the metal can be forced without splashing and without exposure to the atmosphere, the dross, charcoal, etc., being left behind in the crucible. The amount of metal in the crucible must be so adjusted that the mould is filled before the bottom of the feeder tube is exposed, and the air pressure on the metal must be maintained until the ingot has become solid.

The apparatus used is illustrated diagrammatically in the accompanying engraving. A is a cylinderical cast iron vessel closed at the bottom, while the upper end is open and has an external flange. The crucible C stands on a fire-clay support P. The top of the cast iron vessel A is closed by means of a lid B, which is provided with an annular recess R, fitted with an asbestos washer for the purpose of making an air-tight joint with the top of the vessel A, to which it can be tightly clamped by means of a number of screw clamps—not shown in the diagram. The centre of the lid is provided with a hole 3 in. in diameter, into which fits a circular flange piece of steel E, which is screwed to the iron tube D, ¾ in. in internal diameter. This is the feeder tube, and its length is so arranged that it reaches nearly to the bottom of the crucible C. The steel piece E is separated from the lid by another asbestos washer, the object being to form an air-tight joint and also to reduce the loss of heat from the tube D to the cold lid of the vessel. The feeder tube and its holder are held in position by the clamping bar G, which consists of a flat strip of steel slotted in the centre to take the top of the tube, and near the ends to enter corresponding slots in studs H H. The clamping is performed by slipping the centre slot over the projection of the tube, and springing the plate until it is possible to engage the end slots in studs H. H. The "spring" of this strip, together with the weight of the mould, are sufficient to hold the tube in place against the internal pressure in the vessel A. A two-part mould L, fitted with a hole in the bottom, fits over the projecting part of the tube D. The pressure vessel A is connected with a compressed air main through the inlet M, the supply being regulated by means of a delicate needle valve; an exhaust valve N is also fitted. A pressure gauge S is provided.



SKETCH OF APPARATUS.

The requisite amount of metal is melted in the manner described above, except that it has been found convenient to add the aluminum while the crucible is still in the furnace; this is done because it was found necessary for this method of casting

to work at somewhat higher temperatures. When the last addition has been made the crucible is moved to one side of the furnace, and the feeder tube with its steel flange screwed in position is inserted into the furnace and left there until it has reached a bright red heat. The pot is then removed from the furnace, rapidly skimmed free from most of the charcoal, and a little cryolite is thrown on to the surface. The crucible is then placed in the pressure vessel, the surface of the metal being again skimmed to leave the centre portion as clean as possible for the entrance of the feeder tube. The lid is then placed in position and clamped on. While this is being done the runner tube is taken from the furnace, placed in position, and clamped. Then the previously prepared mould is carefully lowered into place. During these operations the exit valve N is left open in order to allow of the escape of the expanding air caused by the heating of the air in the vessel by the hot crucible, feeder tube, etc. As soon as the operations are completed this valve is first closed and then air is slowly admitted to the vessel from the compressed air main. The metal rises in the feeder tube and flows into the mould, the pressure of the air being regulated in such a manner that the mould is filled gently and without splashing. When the metal approaches the top of the mould the rate of flow is gradually reduced, and is almost arrested, the last stages being carried out very slowly. At this stage a crust is formed on the top of the ingot. As soon as this is sufficiently thick, the pressure is gradually raised in the vessel to 30 lb. per square inch, and is maintained at that value until the ingot is solid. The pressure is then released, the clamping bar removed, and the ingot mould with the feeder tube attached is removed from the vessel. The liquid residue in the crucible can then be cast into small ingot moulds. The mould is then opened and the runner removed from the ingot by cutting off with a saw.

A GRADUATE OF THE SCHOOL OF EXPERIENCE SHOWS THE WAY

Illustrative of the value of a detail of practice, there recently came to the editor's attention the following incident. A centrifugal pump for irrigation had been installed in a deep well pit. The engine was started and it pumped water for a few minutes. Then it began to "lose its vacuum" until it ceased to draw any water. A graduate engineer of several years' experience was sent by the pump manufacturer to remedy the defect. He went over the pump carefully, lifted the pipe from the pit and "calked" a few leaks at the joints. Still the pump would not work. He then declared that the trouble was with the well and not with the pumping outfit. So the owners drilled another expensive well. But the same trouble occurred with it, in spite of the fact that the well was larger and appeared to be capable of yielding a great volume of water. The hydraulic engineer was appealed to again, but with the same negative results. Finally an "uneducated" plumber suggested that he could make the pump work. He capped certain connections, and tested the pipe line by filling it with compressed air from an automobile pump. Major leaks in the joints were quickly discovered, and minor leaks were found by squirting oil over the joints, the oil bubbles indicating leaking air. Finally all joints were heated with a blowpipe, and an ordinary candle was held against the hot metal. The melting candle plugged every leak, and thereafter the pump worked perfectly.

The editor of *Engineering and Contracting*, who writes the above, rubs it in as follows: In this case who was the better educated man, the "uneducated" plumber or the "educated" hydraulic engineer? The former solved a problem that the latter had failed to solve. The former saved two wells. The latter would have made them worthless, and worse, for 320 acres of land would have been unproductive. The land is now worth $60,000, because the wells are productive.

TO REPLACE GERMAN CRAFT WITH NEW TRANSPORTS

It is announced by the New York *Journal of Commerce* that John Barton Payne, as chairman of the Shipping Board, has made an agreement with the War Department for the construction of twelve transports of 7,500 tons deadweight each, to replace the German passenger tonnage now being used by the Navy for transport purposes. These vessels will be used by the War Department to replace ships of similar type which were in service at the beginning of the war and are now unfit for further use.

It is stated in Washington that the next recommendation from the Navy Department to Congress will include a request for the construction of a small number of submarines with a cruising radius of at least 4,000 miles. Naval architects have been working upon the development of this type of undersea craft, studying German and Allied fighting submarines as well as the submersible cargo vessels which were used in running the blockade maintained against Germany .

The amputations of limbs among American soldiers during the war were less than 4,000, while it is stated that in connection with American industries there is an annual total of 26,000.

COMPRESSED OXYGEN SAVES SEVEN LIVES

A gang of seven men that took refuge in a compartment of the hold of the Ward Line S. S. *Guantanamo* in Brooklyn recently to escape from ammonia fumes coming from a tank, the head of which had blown out, were rescued through the quick wit of another gang engaged on a job of welding. The welders were at work on a barge alongside the same pier when the news of the accident reached them. The seven men were part of a crew of twenty-five engaged on the repair of a condenser. Under too great pressure, an ammonia tank in the engine room gave way, flooding the room in which the men were working. All but the seven managed to scramble to safety to the hatchways and upper deck.

Cut off from exit, the seven retreated to a compartment far down in the hold, from which they signalled their location by rapping loudly on the plates with their hammers. Their predicament was grave, as the fumes of ammonia, filtering through the crevices, slowly filled the room and made breathing more and more difficult.

The welders rose to the situation by cutting a hole through to the compartment where the men were imprisoned and thrusting down a compressed oxygen pipe line used on their new job. This not only served to blow away the ammonia fumes from the men, but supplied them with comparatively fresh air to breathe for the period of a half hour. Meantime the fire department had been called and Battalion Chief James Heffernan and his chauffeur, Martin J. McNamara, who tied vinegar soaked handkerchiefs over their faces, were lowered into the hold by the welders.

They opened the compartment door and after three trips got all seven men to safety, though the latter were all temporarily blinded from the effects of the fumes and were so weak that they could hardly stand. The heroism of the firemen and the resourcefulness of the welders were the subject of considerable comment in the press.

PAINTS AND VARNISHES "DRY" IN TWO VERY DIFFERENT WAYS

According to the Bureau of Standards the process which occurs when a film of paint or varnish dries depends upon the nature of what is known as the "vehicle."

"Water paints," the report says, "such as whitewash and calcimine, and spirit varnishes, such as shellac in alcohol, dry by simple evaporation of the violatile liquid, this being water in the case of whitewash and calcimine, and alcohol in the case of shellac. The drying of oil paints and varnishes, however, is quite different, and, in order to understand this, attention must be drawn to certain peculiarities of the so-called drying oils.

"Suppose four plates of glass are coated, one with a thin film of water, another with gasoline, another with heavy mineral oil, and another with linseed oil, and all four plates are exposed to the air for several days. The water and gasoline will evaporate and leave the plates dry and practically in the condition in which they were before applying the liquid. The plate covered with the heavy mineral oil will be found to be greasy and in practically the same condition as immediately after the oil was applied. The plate covered with linseed oil will also have a coating on it, but this coat will first become "tacky" and finally set to a hard varnish-like film.

"If this experiment is tried with other vegetable oils, it will be found that some of them—olive oil, for example—behave very much like mineral oils; that is, show only a very slight tendency toward the formation of a varnish-like coating. Other oils, such as those of corn and soya bean, will behave in a manner similar to linseed oil; that is, become a more or less tacky mass, with perhaps the final formation of a varnish-like material."

Some oils are known as drying oils; linseed is one of them. The example quoted above, however, shows that the term drying when applied to oils like these is unlike the drying that occurs when a material wet with water is exposed to dry air.

It is not accomplished by the removal of the water by exaporation, but is due to a change in the liquid itself—a change accompanied by the absorption of oxygen from the air. Although dry weather is a help when a drying oil is applied, the action is helped greatly by the presence of substances known as dryers.

AIR BLOWERS CLEAN THE MOTORMAN'S WINDOW

Accumulations of vapor, steam, moisture and frost on the motorman's windows, of cars on the Ft. Dodge, Des Moines & Southern Railroad, as noted in *Electric Traction,* are removed by means of air blowers. The device consists of two air jets, supplied by two 3-8 in. pipes, each equipped with a nozzle having two openings, 1-64 in. in diameter. An ordinary globe valve, conveniently located near the motorman's right hand, controls the air supply which is taken from the main air reservoir. The apparatus is very efficient in keeping the windows clear so that vision will not be obstructed in bad weather or during the times when conditions favor the condensation and deposition of moisture.

Six Inventions Wanted by the Air Service

THE WAR Department, Air Service, Engineering Division, as a result of its experience during the war, has compiled a list of six inventions which are needed by the military aviation units. By request of the Division, the *Scientific American* has published a brief summary of what is wanted under each head. Inventors who are interested in trying to fill these needs may secure more complete information by addressing the Engineering Division, as above, at Dayton, Ohio.

In the first place, a tank is desired that will withstand a salvo of 15 shots fired at a range of 30 yards, the ammunition consisting of an appropriate mixture of 30-calibre service, tracer, incendiary and armor-piercing bullets. This test must go through without fire occurring in the tank, and it must be successful on 10 successive attempts with 10 separate tanks. In addition, it is provided that the tanks must not weigh more than 5⅓ pounds per gallon capacity, and that the fuel must not be stored under reduced pressure.

Another need is for air-bag floats and landing skids. These are to be used by land machines, usually of the light pursuit type, operating over water. The object is to enable such machines to make an effective landing on the water without capsizing, and to remain afloat after doing so. This has ordinarily been accomplished by constructing the landing-gear axle-spacer so as to form a landing skid, and by storing cloth bags in steamlined housings under the fuselage, together with a tank of compressed air with the necessary piping and valves, and sometimes with an air tank within the fuselage, near the tail. But a more satisfactory design, it is felt, than any now on hand should be possible.

Again, the present portable hangars for field service are usually made of canvas, and are unsatisfactory in that they either blow down in high winds, or leak, or hold pools of water in depressions of their surface, or are too small. Any hangar designed to replace these unsatisfactory articles now in use should be capable of housing at least four De Haviland planes, with room enough left for working on all machines at once. They should incorporate the necessary wiring for electric lights and plugs for extension lamps.

Much is also desired with regard to a suitable gasoline supply gage. The gage should be responsive, serviceable, and *accurate to the last half-gallon.* At present the mounting for the gage can well be left on the tank, as it is thought that the mounting on the dashboard would offer too many complications; still, designs based upon this principle would receive attention.

Perhaps the most immediate need of all is the designing of a single generator and battery which will furnish the power required for the radio installation, the heating and lighting outfit, the ignition, and the motor-driven camera; together with whatever may be necessary in the way of transformers and what-not in order to supply these various units with the electrical energy needed in its proportion and kind. This must be engine-driven in some way, so as to do away with the head resistance of the various wind-driven generators now used. It is almost superfluous to point out that this would be expected to lead to reduction in weight. It is desired especially to have such a design for use with the Liberty Twelve and the Hispano-Suiza; but it is explicitly pointed out that those attacking this problem should think not merely of applying their results to existing motors, but also of developing a set of simple general principles to be incorporated in motors of the future.

A mobile independent cranking device is also wanted, to be mounted on an auto truck. This device is to be an electrically driven cranker for planes not equipped with self-starters; it is to be used at the airdome. The general idea which the Service has in mind is a device mounted on a truck that can be backed up to the front end of any plane, and then a flexible arm attached to the propeller. The electric energy is then to be brought into play which will crank the engine and cause it to begin firing. When the engine picks up, the device should automatically be thrown out of connection with the propeller.

Among the data which the Division is prepared to put at the disposal of those who attack this problem is a statement of the previous experiments, so far as known to the Division.

THE TIN PLATE INDUSTRY

Twenty years ago we did not produce a pound of tin plate in this country, but imported over a billion pounds in 1891. Last year our production was over 3,000,000,000 pounds, our exports over half a billion pounds and our imports insignificant. The value of our product was over $200,000,000 and represented more than three-fourths that consumed in the world.

This is largely a Pennsylvania industry, just one of many, but an illustration of what can be done when an industry is protected by adequate import duties.

WAR INDUSTRIES OF THE BALDWIN LOCOMOTIVE WORKS

Record No. 93 sent out this year by the Baldwin Locomotive Works has never been surpassed in the series for the attractiveness of its makeup and the intrinsic value of its contents. This issue has to do entirely with the output of the complete organization for war purposes beginning with Nov., 1914, and besides the host and variety of locomotives shown there are also the baby gun mounts, the military rifles and the masses of shells of various calibre.

Most impressive of all is the condensed summary, here reproduced, of the grand total of accomplishment.

LOCOMOTIVES

Broad-guage steam locomotives	3246
Narrow-guage steam locomotives	1146
Broad-guage gasoline locomotives	20
Narrow-guage gasoline locomotives	1139
Total	5551

SHELLS

(Including those manufactured by the Eddystone Ammunition Corporation and the Eddystone Munitions Company.)

3-inch shrapnel	2,300,000
75 m/m shells	2,351,555
4.7-inch shells	225,399
5-inch shells	150,281
6-inch shells	1,068,157
12-inch shells	112,553
12-inch forgings	9,000
220 m/m shells	213,615
270 m/m shells	134,795
Total number of shells	6,565,355
Cartridge cases	1,863,900
Miscellaneous ammunition items	1,905,213

GUN MOUNTS

14-inch railway mounts	11
Foundations for 14-inch, mounts	20
14-inch railway mounts, improved type	2
7-inch caterpillar mounts	38
Trucks for gun and howitzer mounts	5 sets

The total number of rifles manufactured at the Eddystone rifle plant was approximately 2,200,000.

The aggregate value of the war contracts executed and delivered by The Baldwin Locomotive Works and its associated companies, the Standard Steel Works Company, the Eddystone Ammunition Corporation, and the Eddystone Munitions Company, was approximately $250,000,000.

The product turned out was not for the United States alone but largely also for Great Britain, France and Russia. A suggestion of the magnitude of the war demand is given in a single sentence: "In the attack and defense of Verdun, for example, approximately 60,000,000 shells, representing 3,000,000 tons of steel, were expended in thirty weeks; and the railways moved the greater part of this material to the firing line."

A NEW RIVET FORGE

A rivet heating forge of a new type, the invention of an employe of the Pacific Coast Shipbuilding Company, is described in *Full Speed Ahead,* the paper published at the plant of the company on Suisun Bay, thirty-five miles east of San Francisco. The account says:

An improved oil forge for heating rivets has been devised by J. T. Shepherd, plant plumber. Several of the forges are already at work. One of their most commendable features is the avoidance of backfire. Higher vaporization of the oil is secured through the use of the new invention.

The main features are a valve on the air line and a needle valve on the oil supply, with a mixing chamber. The latter is formed of a 1¼-inch T with a 1¼-inch nipple and a bell reducer reducing to ⅜. Above this is a second mixing chamber, formed of a 1-inch ell, the oil being carried thence through a 1½-inch T with a ⅜-inch nipple, forming an injector. Free oxygen is taken in with the vapor.

There is a ¼-inch vent on the tank, to make filling quicker, the vent forming a suction on the funnel. It is not necessary for the boy to go to the manifold to turn the air off. This is done right at the furnace. Another advantage is that the new forge needs no labor to connect the hose. A male hose connection is used, obviating two couplings.

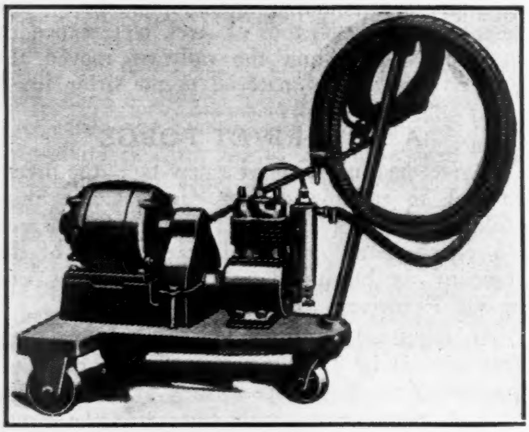
The piping on the end where the valves are controlled is protected with a stay plate, reducing the danger of damage to the forge. The danger of backfire is eliminated by fire clay sealing.

The forges are also equipped with bleed valves, making it possible to clean out the tanks easily. Not only can water be bled from the oil, but the bottom of the tank can be blown clean.

Shepherd, who has been working on the forge design for some time, gave it to the company as a contribution to the yard's productivity.

SMALL PORTABLE AIR COMPRESSOR

The little, handy, electric driven, fully equipped air compressor here shown should appeal to many of our readers who so frequently address inquiries to us for such a machine. Little description seems to be called for. There are two vertical, single acting, air cooled cylinders 1¾ in diameter and 2 in. stroke, the delivery being about 2 cu. ft. of free air per min.



THE MASTER AIR OUTFIT

The rig, which can be connected to any regular electric light socket, is here shown mounted on a little truck, but it is so light that it can be easily lifted around without this. It is known as the "Master" air outfit and is built by the Hartford Machine Screw Company, Hartford, Conn.

THE GAS TROUBLES OF THE DIRIGIBLE

The most serious and perplexing practical problems in connection with the operation of the dirigible have to do with the gas content of the balloon, not merely as to the leakage of the gas outward, which seems to be not entirely preventable, but also as to the inword leakage of the surrounding air and the constitution of the mixture which results. This matter is informingly discussed in a recent issue of *Aviation*, to which we are indebted for the substance of what follows.

Permeability to gases is an inherent property of rubber and it can only be modified, not eliminated, by the method of manufacture of rubber coatings. The best of the modern airship fabrics seldom have a permeability of less than 8 liters per square meter (.236 cu. ft. per square yard) in 24 hours, measured at 25 degrees Cent. (77 degrees Fahr.). Thus it comes about that there is always some diffusion of air into, and of hydrogen out of, a balloon, quite apart from the leakage of hydrogen which takes place through holes in the balloon when the pressure inside is greater than the pressure outside. The relative rates of penetration of rubber by hydrogen and air are not the same but are in the ratio of four to one; that is, when the envelope contains approximately pure hydrogen, one volume of air passes through the fabric into the balloon for each four volumes of hydrogen leaking out. But the "air" passing into the balloon is richer in oxygen than normal air, owing to the fact that rubber is about twice as permeable to oxygen as to nitrogen. The method of determining the purity of balloon gas by measuring its oxygen content and assuming that nitrogen is present in the proportion in which it occurs in air is therefore obviously in error. A better method is to determine the specific gravity of the gas in the envelope, when the error in estimating the purity from the result, without actually finding the relative amounts of oxygen and nitrogen in the gas, is very small on account of the small difference in the densities of these gases. The determination of the oxygen content may be useful, however, from another standpoint, that of the determination of the stage at which the balloon gas becomes an explosive mixture. This stage is reached with a greater percentage of pure hydrogen than would be ordinarily the case, since the oxygen content of the "air" diffusing into the balloon is so high.

A PORTABLE DIVING BELL

Although what we may call the old fashioned diving bell now seldom figures in print, the armored individual diver having deprived it of much of its formerly legitimate employment it still finds employment for special conditions. The *Technist Tidskrift* gives an interesting description of the bell used for the Central Harbor at Gothenburg. The bell as described consists of an upright chamber, 32 ft. 10 in. long by 24 ft. 8 in. wide, suspended from an overhead traveling crane with longitudinal and transverse travel. It is supported from rails resting on piles driven along the quay wall and securely held in position by diagonal struts, as cross ties would have interfered with the working of the bell. It is provided with two air-locks, one for workmen, and the other for materials, the air chamber is 11 ft. 6 in. high, arranged for water ballast tanks on top. To sink the bell, water is pumped in by a 4 in. electrically driven centrifugal pump. The maximum air pressure used is 21.3 lb. per sq. in. above atmosphere equivalent to 50 ft. of water. The quantity of water in the tanks is regulated by the air pressure through a special valve which permits surplus water to overflow

and adjusts the total weight of the diving bell to the depth of immersion. Compressed air is supplied by a blowing engine erected on the top of the diving bell and driven by a 6 h. p. electric motor. It is capable of delivering 350 cu. ft. of free air per minute at a pressure of 21.5 lb. per sq. in. The lower edge of the diving bell can be raised 5 ft. above water level in order to be quite clear of the quay wall which is a shell of reinforced concrete with a heavy top and suitable partition walls. It is constructed in sections of 164 ft., which are completed in two weeks, the wooden forms being fixed the first week, and the concrete cast the second week. The whole of the work is executed under compressed air, the diving bell being raised as the work proceeds.

FRESH AIR

The Arizona Anti-Tuberculosis Association, addressing chiefly a local clientele, has some things to say about air conditions which should be applicable and worth heeding everywhere.

A clear distinction should be made, it says, between "cold" air and "pure" air, the one not necessarily employing the other. Many people, in their efforts to prevent tuberculosis, are obsessed with the notion that all cold air is pure air and that all warm air is impure air, and there is danger in the notion because it gives a false assurance of security.

It has been found sometimes by tuberculosis patients that sleeping porches do not always give the expected results. There are instances where sleeping porches are found to be "dead air" pockets. Moreover, the outside air is not necessarily always pure air, although the chances are in its favor. The outside air in the close vicinity of a smelter, for instance, tends to kill vegetation and is harmful to animal life. It would not do for a tuberculosis sufferer to depend on outside air in such a region.

The open window does not necessarily insure a sufficient supply of pure air, although it is, of course, preferable to the closed window. In addition to opening the window, provision should be made to secure some circulation in the room so that the air will not become "dead" air. This is the same as creating a draft and many people will be horrified at the advice, the fear of a draft being deep-rooted.

The ideal way is, of course, to sleep in the open air with sufficient protection to insure the sleeper against cold and rain. The next best way is to have at least two windows open to secure circulation.

Worst of all is the idea that cold air in a closed room is preferable to warm air in a closed room. Cold air in a closed room cannot long remain pure. It becomes laden with carbon dioxide gas from the lungs of the persons living or sleeping in the room. The only difference between a closed room with cold air and a closed room with warm air is that the former is more uncomfortable than the latter. Reasonably cool air is both living rooms and sleeping rooms is highly desirable, but the coolness must come from the outside and must be mixed with purity to be effective; it must not be cool simply because of the absence of heat.

COMPRESSED AIR TO STIR THE PAINT

Our readers should be by this time quite familiar with the use of compressed air for the actual operation of painting. A writer in a recent issue of *Factory* calls attention to another important use of air in large paint ships.

Nearly all large plants, he says, have paint rooms of their own. Here is stored the paint supply of the whole factory. Because of the tendency of the paint to settle, it must be stirred up each time any quantity is withdrawn. As a rule, the stirring of paints by hand is done to the accompaniment of aching muscles and breaking backs. One good-sized factory, however, performs the whole operation by the turn of an air-cock. There happens to be a high-pressure air supply handy to the paint room. Paint is kept in barrels each containing a double wooden paddle. When the paint requires stirring, a pneumatic reaming tool is slipped over the end of the paddle shaft which projects above the barrel top. This shaft is held in place by two crossed pieces placed across the barrel head. By using the shaft in place of a reamer shank, the paddle is whirled rapidly and the paint mixed in a surprisingly short time. After one barrel of paint is mixed thoroughly the reaming tool is slipped over the paddle shaft in the next barrel. Thus the whole job is done quickly and with little labor.

The man who adopts familiar equipment to new and useful ends is many times more valuable to his employer than the one who calls for a special machine for each new job that develops. Compressed air is a valuable and easily adaptable power around a plant.

AN AIR COMPRESSOR AS A WATER HEATER

We are credibly informed of what we must characterize as a case of perverted ingenuity or a reversal of normal function of apparatus in the shops of the San Francisco Fire Department. They have here quite naturally an air compressor supplying compressed air for various uses around the shops, and the air cylinder of this is very

properly provided with a water jacket. The water jacket as we all know is normally a cooling device for keeping down the temperature of the air cylinder and also for cooling the air as much as possible while undergoing the operation of compression.

In the case here spoken of the water jacket of the air cylinder is regarded and is treated as a heater of the water rather than a cooler of the cylinder and its air content. A tank for hot water for labatory purposes has been placed near the compressor and at a height of three or four feet above it. This tank is kept full of water, and it is connected by two unobstructed pipes with the water jacket. One of these pipes is connected with the top of the jacket at one end of the air cylinder and the other pipe with the bottom of the jacket at the other end of the cylinder. When the compressor is put in operation and the cylinder begins to get hot the water also is warmed and begins to circulate, rising to the tank through one of the pipes and descending by the other pipe as in any water heating system. As the compressor keeps going the water naturally gets hotter and hotter, but the compressor cylinder and the compressed air do not get cooler and cooler. It should not be necessary to say to anybody that the coldest water available should be supplied in constant free flow to the water jacket.

ALCOHOL HEAVILY HANDICAPPED

The following is not provoked by current prohibition legislation but deals with alcohol as a source of power, and is in fact the opening paragraph of an important editorial in *The Engineer*.

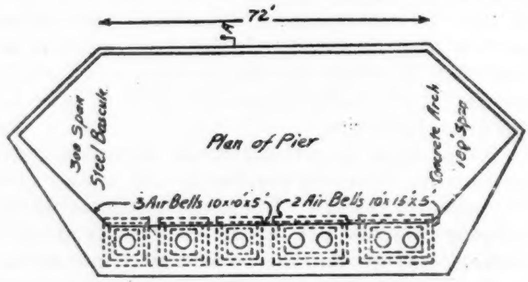
Alcohol, produced by the distillation of vegetable growth, differs from all other liquid fuels in one very important respect. Mineral oil, coal, peat, lignite, and other natural fuels were, as far as we know, all "manufactured" thousands, in some cases millions, of years ago by cosmical forces. They cannot be renewed by the will and action of man. Alcohol, on the other hand, is derived from a source which must remain inexhaustible as long as the earth sustains plant life, for it may be derived in greater or lesser quantities from practically all vegetable matter. For this reason it makes a claim to the highest consideration.

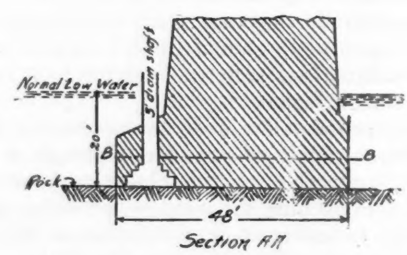
But it suffers from two serious drawbacks. In the first place, unlike coal or wood, or raw oil, it does not exist as a ready-made fuel; it has to be manufactured by the art of man. In the second place, it has the unfortunate quality that it leads to intoxication. How much it has suffered from the second defect it is impossible to estimate, but, possessing as it unquestionably does the highest merits as a liquid fuel, we can scarcely doubt that, had it not been gifted with this unfortunate quality, had it not been the basis of all the potable liquors which fall under the control of the Board of Customs and Excise, it would long ago have won a position in the industrial world, from which it has been debarred partly by the natural failings of weak humanity, partly by the over-zeal of temperance advocates, and partly by the advantage that accrues to the State from its taxation. If only alcohol were as inconceivable as a beverage as Russian oil, it would have enjoyed that position in the world of industry to which by its merits it is entitled.

COMPRESSED AIR FINISHES A TREMIED FOUNDATION

A novel and ingenious method of securing a satisfactory foundation under difficult conditions as employed by the Navy Construction Company in building one of the bascule piers for the Market Street bridge over the Tennessee River, at Chattanooga, is described in *Engineering World* September 15.

The pier supports a 180-ft. concrete arch span





Section AA

on one side and a 300-ft. steel Scherzer rolling lift span on the other. It has a foundation about 48 ft. wide and 72 long, exclusive of the triangular noses. It is founded on limestone rock about 20 ft. below normal low water. The roadway is about 70 ft. above this water level, making the pier about 90 ft. high. The limestone rock is overlaid with about 5 ft. of gravel. A steel cofferdam of United States steel piling was first driven and the excavating was done under water with a ¼-yd. Lakewood clamshell bucket.

It was found impossible to pump the cofferdam dry although it was divided in halves by steel piling. This was on account of the huge fissures in the rock through which the water boiled in such volume that made pumping it dry impossible. Divers with a sand pump cleaned up the bottom. Five air bells, as shown in the sketch, were made of 2-in. planks with a 3-ft. diameter steel shaft bolted on top of them. These bells were sunk on the channel side of the pier, after which about 6 ft. of concrete was tremied* over the entire foundation. After the concrete was set up the cofferdam was pumped out and the remainder of the pier built in the dry.

An air lock was placed on the bell shafts, one at a time, and the large crevices in the rock under the bells were cleaned out, the timbers torn out of the bells and the bells concreted up under air pressure. The shafts were then cut off above the top of the foundation.

The huge crevices in the rock were filled with soft yellow clay and it was impossible to clean them out with the divers and sand pump. In order, therefore, to be sure of a good bearing for the pier on the bascule channel side, where the highest pressure is, the air bell method was devised, adopted and proved to be satisfactory.

*A tremie is defined as "an apparatus for depositing and consolidating concrete under water, essentially a tube of wood or sheet metal with a hopper-like top. It is usually handled by a crane." In the vertical section in the cut the concrete below line B B was tremied.

THE BUSY PAINT GUN

An issue of the *Scientific American* last summer bore upon its front cover an attractive picture in colors showing the interior of an automobile factory with a workman painting a wheel with the aid of compressed air. The use of the paint gun, as it is now coming to be familiarly called, is no longer a novelty but it is still interesting, and the account given of its extensive employment, in connection with the suggestive illustration referred to will be found well worth reading.

The modern method of applying various kinds of points and other protective coatings by the use of compressed air is rapidly superseding the old hand-brushing method, not only by reason of the great saving in time and labor, but also due to the fact that better results are obtained.

There is hardly a comparison between pneumatic painting and the old-style way. One handy workman, for instance, can do the work of three to twelve or more skilled painters using hand brushes, depending upon the nature of the work. Uniformly finished coatings free from streaks and brush marks are produced. Rough, irregular surfaces and those inaccessible or difficult to reach with a brush are readily coated. Where single coat work is required, either a lighter or heavier coating can be obtained than is possible with hand brushes. The gun, for such is the usual name of the pneumatic painting device, may be quickly mounted on an extension pole attachment for painting surfaces beyond the reach of the operator. The air-tight material container prevents the formation of paint skins, and makes it impossible to combine dirt with the paint. These are but a few of the leading advantages of the pneu matic system of painting.

Penumatic painting equipment consists of a container; a flexible, metal-lined hose; a heavy rubber air hose; and the paint gun or nozzle member. Some materials require continuous agitation in order to keep the heavier parts in suspension, and for this purpose an agitating attachment is employed. This device is screwed into the main air port in the bottom of the control head. The agitating is done by air, which, after passing through this attachment and bubbling up through the paint, is allowed to escape through the bleeder valve in the control head. When using certain varnishes and enamels, on the other hand, it has been found that, in order to obtain the best results, the air should be heated before it reaches the gun. If this is done and the material is also heated before being placed in the material container, a perfectly smooth coating can be obtained. For this purpose an electric heating attachment is sometimes used with a pneumatic painting equipment. This attachment may be operated from any ordinary electric light socket. It is so designed that it may be turned on at the same time as the gun trigger is pulled by the natural grip of the hand.

Compressed air for the paint gun is generally supplied by a compressor unit which may serve several paint guns at one time.

Today paint guns are employed to a very wide extent. In many industrial establishments they are employed for all kinds of painting. In the production of explosive shells during our participation in the world war, the old inefficient method of applying protective coatings by dipping, pouring, and swabbing, was dropped in favor of pneumatic painting.

It is announced that plans are being made at Chicago by the "Our Country First Conference" which was formed in that city this autumn under the auspices of the Illinois Manufacturers' Association, to organize all business; farming and commercial associations in the United States into one body to deal with social unrest and "the preservation of individual and property rights."

COAXING WINDMILLS IN DENMARK

During the coal famine caused by the war many attempts were made especially in Denmark to improve the working of the windmills geared to dynamos to generate electricity. About 250 installations on farms and small estates have proved fairly satisfactory. Many experiments in this connection were carried out by the late Mr. P. la Cour, and a trial mill designed by him is still being used for observation purposes. During about one-third of the year there was either complete absence or excess of wind, and the force available was very variable. It was nevertheless found possible to save fuel for steam or gas-driven power producers. The cost per kilowatt from peat gas fired plants is approximately the same as from a windmill-driven installation. Attempts were made to design special three-phase dynamos capable of maintaining constant voltage independent of the speed of the mill, special attention being also paid to automatic adjustment of the sails in order to reduce the cost of attendance.

COMPRESSED AIR LOADS AND UNLOADS COAL CARS

The accompanying half tones illustrate a special employment of compressed air at the plant of the King Coal Company, Oakland, California. The air is here used for both opening and closing the doors on the drop bottom cars and also for opening the gate of the hopper from which the cars are loaded. By this arrangement one man operates the entire train of three cars, receiving the coal into the cars, running them along the track and then dumping the load.

Fig. 1 shows the operator and his various levers, Fig. 2 shows the hopper from which the cars are loaded and in Fig. 3 the cars are seen upon the dumping trestle.

FIG. 1—THE OPERATOR AND HIS LEVERS.

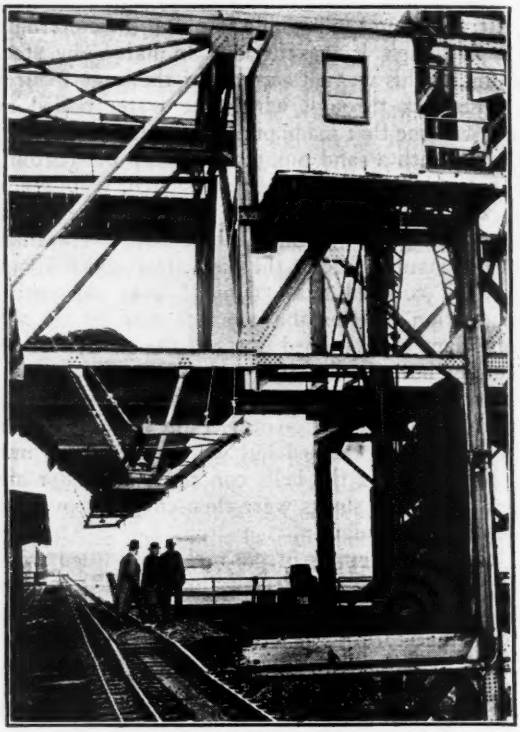


FIG. 2—HOPPER FOR LOADING CARS.

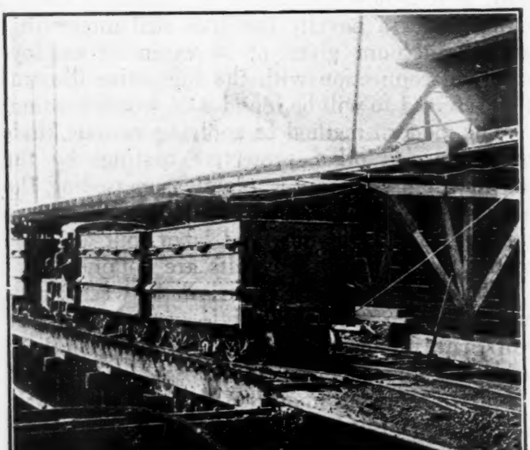
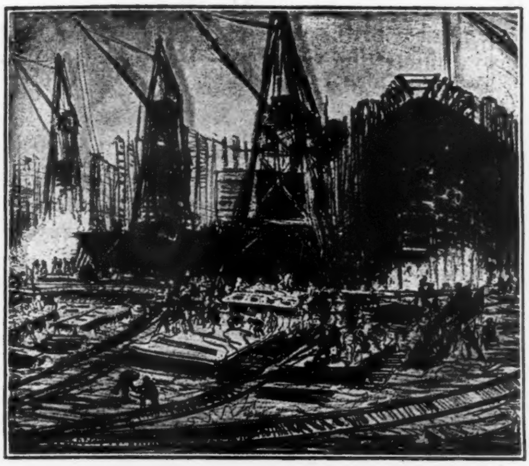


FIG. 3—CARS ON DUMPING TRESTLE.

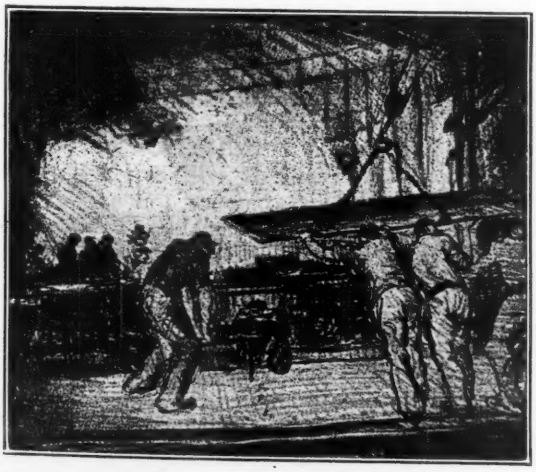
THE SHIPBUILDERS*



Incessant, harsh, staccato, up from the shipyard rises the roar of the hammers.
From its weird, runic undertones, strange voices come to the poet:
Long soft sighs of the Norther through the pines on Oregon hillsides;
Murmur of mountain streams; wild crashings of mighty waters
Harnessed by pygmy men to force his designs upon nature.
Come with me through the shipyard and see through the eyes of the artist
How man applies this power to force his designs upon nature.

The Steel Shipyard

Here man is dragging great bars of steel white hot from the furnace.



The illustrations are from lithographs drawn on stone by Carl Walters of Portland, Oregon, and are reproduced from the Pacific Marine Review by courtesy of the G. W. Standifer Construction Corporation.

Smash! Press! Shear! He will shape them anew to his purpose.
Drill! Punch! Scarph! Bolt, plate and angle and zee bar
On white hot rivets roar the hammers, and ere night
Black against the twilight sky looms the forward bulkhead.

The Wood Shipyard

Mighty timbers of pine, sawn from the Lord of the Forest
Man will attack with saws and dubber and planer and hammer,
Driving home bolt and treenail until, as if by magic,
Framed and planked and caulked, a ship stands ready for launching.

* * * *

Thus the brush and the pen sense the rough, fierce power of the worker
Who at his country's call threw steel and wood into ship shapes—
Mighty the will of man, all subduing, all comprehending.

TRUE VISION

Agitators and their dupes, those who block the wheels of a nation's progress, those who hinder the solution of pressing problems, those who wreak havoc in the lives of millions for fancied self-interest, are commended to a careful perusal of Frederick Moxon's "True Vision," which we take great pleasure in reprinting from our excellent neighbor, *Power*:

The nation's business—yours and mine—
By what authentic, certain sign
Shall it be given us to see
The growth of true prosperity?

By whirr of spindle, hum of wheel?
By stroke of hammer, clang of steel?
By busy docks, car-crowded rails?
By daily food that never fails?

"Not so," replies the dreamy drone,
Who knows no vision save his own
False paradise of workless days,
With "Business" a discarded phrase.

But for the patriot brain and heart
That bravely seek their place and part
In building up the nation's power,
Shines triumph in the present hour.

Theirs is a vision deep and wide,
The stimulus of worthy pride;
For in true work true men employ
Life's gift of service, linked with joy.

Advertisements are meant to "pull." In the course of the war an office manager, according to the *Nation's Business,* tried to put pulling power into his advertised desire for a messenger. The advertisement he printed read: "Boy wanted—Young or Old—Either Sex."

Notes of Industry

Boulders encountered in excavating the Cape Cod Canal, some up to 80 tons, were removed by blasting. The blasting was usually done by placing charges of dynamite on top of the boulder, depending on the overlying water to serve as tamping. The explosive used was 75 per cent. gelatine dynamite in charges from 25 to 200 lb. The best results seemed to be produced by charges of about 50 lb., even if they had to be repeated.

The power required to drive a flat transverse surface through the air is, in horse power per square foot, approximately 6 millionths of the cube of the velocity in miles per hour, or say, v^3,000,006. Every square foot of transverse surface therefore, in an automobile or airplane, requires, to overcome the air resistance alone, about ½ h.p. at 43 m.p.h., 1 h.p. at 55 m.p.h., 2 h.p. at 70 m.p.h., and 3 h.p. at 80 m.p.h.

The airplane record with passenger from Turin to Rome was broken this year by Lieut. Brack-Papa, flying a Fiat B R. biplane equipped with a Fiat 700 horse-power twelve-cylinder engine. The distance of 362 miles was covered in of 161 miles an hour. The previous record with passenger over the same route was 2 hr. 50 min., and was established by Sergeant Stoppani on a Sia machine.

It became public at the recent annual Convention of the American Federation of Labor that its membership at present is 3,250,068. There is a cash balance in its Treasury of $192,490, the receipts for the year being $654,687 and the expenditures $587,518.

Albert Brunt, who for the last four years has been engineer in charge of the direct-current machine design section of the industrial engineering department of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, has resigned to return to Holland, his native country. Mr. Brunt was born in Woerden, Netherlands, Nov. 6, 1883, and received a complete education in the schools and universities of that country. His technical training was received at the University of Delft, where he took the degree of mechanical engineer in 1905 and electrical engineer in 1906. For two years following this, he was employed in design work with electrical manufacturing companies on the continent. In April, 1909, he came to America and entered the Westinghouse employ. Mr. Brunt was an active member of the A. I. E. E. and has prepared several interesting articles for technical papers on direct-current motors.

"Two popular methods of getting killed," is the title of the latest safety-first pamphlet issued by the Pere Marquete and other Michigan roads. The two methods are the highway crossing method, and walking along railroad tracks. Interesting comparisons are drawn between these American methods and ancient method for the same purpose. The ancients are believed to have had the better ways.

A report of the Mechanics and Metals National Bank of New York says that, on the extreme quotations for the month of June, it cost the Englishman $1.14 to buy $1.00 worth of American goods; the Frenchman, $1.42; the Italian, $1.67; the German, if he were buying, $4.00. On the other hand, the American could buy a dollar's worth of goods for only 88c in England; 70c in France; 60c in Italy, and 25c in Germany.

In a recent U. S. patent for non-inflammable celluloid the claim reads: "the method of subjecting low-inflammable celluloid material to a pressure of not less than about 300 kilograms per square centimeter." This would be more than 4,000 pounds per square inch. How the high pressure could affect the inflammability is not apparent.

In view of the increasing use of oil instead of coal for power development, it will be noted with interest that in the enormous shipbuilding plant of Harlan & Wolff, at Belfast, Ireland, oil has thus supplanted coal. It will be remembered that this firm also uses compressed air very extensively, having more large hammers now driven by air which normally would be steam driven than any other concern in the world.

That the airplane engine is not above ordinary humdrum work is shown by the fact that one has recently been installed in a London factory as a stand-by power unit. It burns gas instead of petrol and the cooling water is circulated through a common cast iron radiator. It is an eight-cylinder engine, surplus from the war, and at the aerial rate of living would develop 200 horse-power, but has been rated at 75 horse-power on earth to give it a reasonable length of life.

A Self Contained and Unusually Portable Air Compressor

By H. L. HICKS

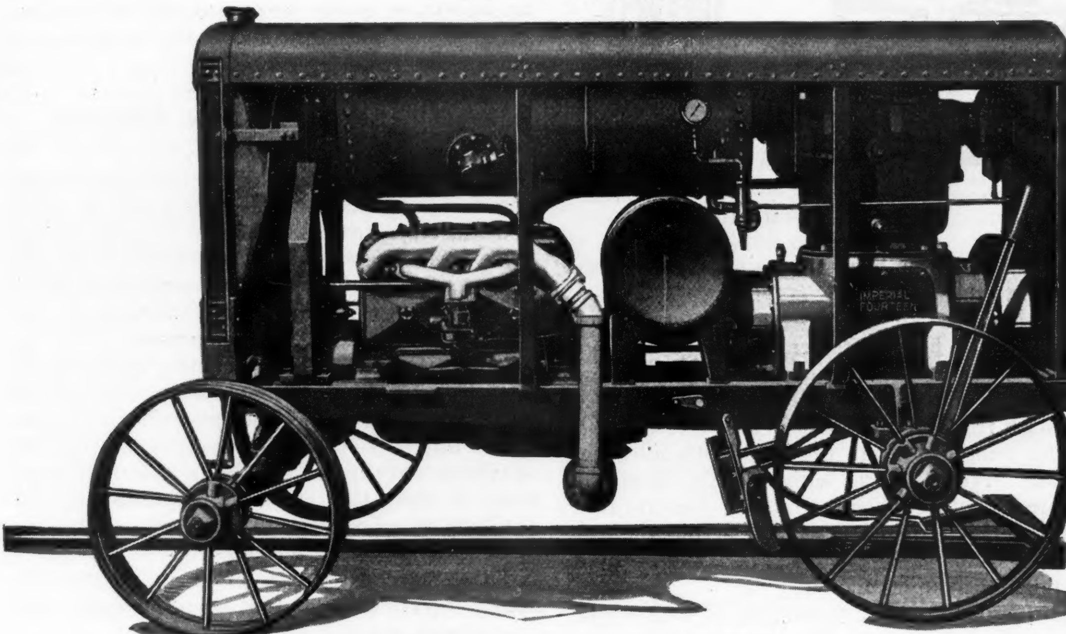


FIG. 1—THE LARGER OUTFIT COMPLETE

THE ONLY thing that for years has kept the contractor from equipping his men with the various pneumatic labor saving devices has been the trouble and expense of installing air power plants for short-time jobs. Despite the advantages incident upon the use of air operated tools, he has found it difficult to justify the costly transport of a cumbersome stationary machine, the building of a shelter, the setting up of a steam boiler, perhaps, and the laying of a pipe line for only temporary use. Then, too, he had to count on tearing down the plant when the job was complete.

The coming of the portable type of air compressor was a great boon, though quite often, "portable" was somewhat of a misnomer, and meant merely "mounted on wheels." Portable air power equipment, however, did away with the expensiveness of compressed air on temporary jobs and soon became an indispensable part of the contractor's equipment. Portable outfits of many varieties have been developed in the few years just past, each successive design bettering the one which preceded it, and now there appears a new type.

The Ingersoll-Rand Company* has recently introduced a light weight gasoline-engine-driven unit, built in two sizes, to be known as the Imperial Type 14 Portable Compressor.

*11 Broadway, New York.

These portable compressors are all-steel outfits, from their sheet steel canopies to the broad tired steel wheels. The power plant of each consists of a duplex, vertical compressor, driven, at high speed, by a four cylinder, four cycle, tractor type gasoline motor. It is pointed out that the outfit, being designed especially for portable use, has had unnecessary weight eliminated, and affords maximum air power output per unit weight. The larger machine, Fig. 1, of 210 cu. ft. capacity, weighs only 6000 lbs. and the 118 cu. ft. unit 4000 lbs. A point is also made of the fact that gasoline motor drive provides power in economical form and in a mechanism that can be confidently entrusted to the average operator, for men familiar with gasoline engines are everywhere available and make thoroughly competent engineers.

The compressors have cylinders, single-acting, cast en-bloc, with cylinder heads, valve chambers and water jackets integral. Both intake and discharge valves are of plate type and are located directly above the cylinder bore. Crank shafts and connecting rods are drop forgings. Air pistons are fitted with three-piece piston rings and, in addition, with an oil wiper ring. This latter returns all surplus oil from the cylinder wall to the crank case, and is claimed to obviate the

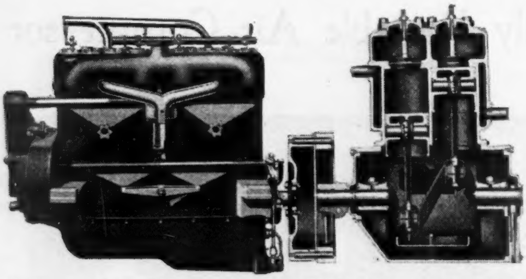


FIG. 2—POWER PLANT SECTION OF THE SMALLER MACHINE

difficulty caused by having the air carry an excess of oil into the receiver.

All bearings are die castings of anti-friction metal. Hand holes in the crank case permit convenient access for adjusting main bearings and those of the crank pins. All parts are lubricated by splash from an oil reservoir in the crank case.

The compressors are provided with inlet unloading devices which automatically close the compressor intake when the receiver pressure rises above a predetermined limit, and permit the machine to again take up its load when the pressure has fallen a definite amount.

The gasoline driving motors are of long stroke type, and operate at medium speed. They are equipped with high tension magneto ignition, with automatic governors to maintain constant speed under all working conditions and to prevent overspeeding when idling. A splash oiling system lubricates all moving parts. Starting crank is located at the front of the machine beneath the radiator.

Both compressor and driving motor are water cooled by a circulating system, with centrifugal pump, large radiator and powerful blast fan. The manufacturer directs attention to the fact that the radiators are made up of removable sections, a construction which allows the removal and repair of a damaged section without taking down the entire radiator or interrupting the use of the compressor.

Each of these units is equipped complete with receiver, safety valve, drain valves, pressure gauge and service valves to which the air hose lines may be attached. When the fuel tank has been filled, lubricating oil provided and the cooling system supplied with water, the units are ready for work.

The mounting of the machines is worthy of note, particularly the swiveled front axle which moves freely in both horizontal and vertical planes. This, with the rigidly attached rear axle, gives three-point suspension, and permits the outfit to pass over inequalities of the ground without any racking effect or misalignment of the power plant.

The two sizes differ in respect to the location of the air receiver and in minor details of design. These differences are, in general, to be seen from an inspection of the accompanying illustrations. Fig. 2 is a section of the engine and compressor of the smaller outfit.

COMPRESSED AIR IN THE OIL REFINERY

The air compressor is a very useful and necessary unit in the modern oil refinery and the variety of the employments for the air is worth noting. Some of these uses of the air mentioned in the following summary by the superintendent of one of the biggest refineries in Tulsa, Oklahoma.

Air is compressed in six compressors to a pressure between 110 and 125 pounds for the operation of riveting hammers and air motors for drilling and reaming in the machine and boiler shops. Air at this pressure also is used for blowing out oil lines, after pumping the products through them, to clean the lines; also for pumping wax distillate or refined wax so as not to permit the product to remain in the lines.

Three more air compressors, handling approximately 3,000 cu. ft. of free air per minute, with a maximum pressure of 50 pounds, are used for agitating batches of both refined oil and lubricating oil, as well as wax distillate in treating. Low pressure air also is used for blasting the filters, that is, for breaking up the settled mass of Fuller's earth after it has been used for filtering.

Three more large compressors handle approximately 3,500,000 cu. ft. of gas which is compressed up to 250 pounds per square inch for the extraction of gasoline. Compressed air also is used in the plant for transporting sulphuric acid, for the testing of stills, tanks and railroad air brake equipment, and for agitating foam fire-fighting solutions.

Most of these compressors are now steam-driven units, there being two electrically driven compressors in the plant; but where conditions are favorable and electric motor drive is possible, in future installations motor drive will be used.

John Ericson, Chicago, has resigned his position of city engineer to accept the post of consulting engineer for the Board of Local Improvements. P. S. Combs was appointed his successor and will be assisted in the work by V. S. Patterson, assistant engineer.

LeGrand Brown, formerly an engineer in Rochester, N. Y., who has been engaged in consulting work in California for a number of years, has been appointed deputy city engineer of Rochester.

GASSING THE GROUND SQUIRRELS

On the line and in the neighborhood of the Pacific Electric Railway ground squirrels have been proving a costly pest. They breed in vast numbers and they burrow into the banks of the cuts, the abutments of bridges and elsewhere and they also do great damage to the crops of the farmers. Poison and other devices have been tried for their extermination but with little satisfaction or any assurance of permanent relief. The company spoken of has, however, now found a means of keeping down the nuisance. This is by the use of asphyxiating gases in the burrows.

There is in the market an automatic distillate vapor machine which does the business, killing not only the squirrels but also other predatory animals, such as rabbits, badgers, snakes, owls, etc. Regular engine distillate is used in the machine which produces a white vapor. The gas when generated is forced into the burrows, effort being made to have the wind in the operator's favor so that the gas may reach as deeply as possible. Other details of the operations involved as developed in practice it is not necessary to particularize here.

Upon entering a cut to gas, one foreman and four assistants work together. Two men with a gas machine work on one side of the cut, while two more with a second machine take the opposite side. The best time to gas is after a rain, when the holes have been opened up by the water. One foreman and four men will average eighty main burrows in a ten hour day, the two machines consuming three gallons of distillate in the period.

DANISH FLEET TO CARRY COAL FROM U. S. TO DENMARK

As a result of a statement made public in these columns last month and elsewhere, by the Shipping Board's Division of Operations, and in which it was shown that Europe, despite its dire need for coal, was diverting its own tonnage to the more profitable trade routes, leaving to America the job of carrying the less profitable coal cargoes to Europe, the Danish Legation subsequently announced that sixteen steamships, aggregating 61,000 tons were to be immediately placed in the coal trade and will carry coal from this country to Denmark.

This prompt response of Denmark has been very gratifying to the Shipping Board as the assignment of this large fleet will greatly aid the Board in caring for European fuel needs. Word also was received by the Shipping Board that Sweden was taking cognizance of the situation and was preparing to place its vessels in the American to Sweden coal trade.

The Shipping Board has been further advised by the Italian High Commission to this country that the Italian vessels previously announced by the Shipping Board as carrying coal from the United States to Gibraltar were in reality carrying coal from the United States to Italy, being diverted from Gibraltar to various Italian ports. This news further emphasizes the statement made in the announcement of the Shipping Board that the Italians were putting forth every effort to assist themselves in this coal crisis.

LIQUID OXYGEN

In a lecture by Sir J. Dewar at the Royal Institution, London, it was stated that the total output of the twelve factories producing liquid oxygen in England was 1,000,000 cubic feet, say 118 tons, per day, of which 85 per cent was used for cutting and welding metals and 15 per cent for medical purposes. In Germany one plant alone was producing 100 tons per day.

Liquid oxygen has been much used by airmen flying at high altitudes. For this purpose it is stored in vacuum vessels provided with a mechanism for controlling the evaporation, and with tubes leading to a mouthpiece through which the aviator may inhale. There are three types of mechanism. In the first, the liquid is heated electrically; in the second, the evaporation is promoted and controlled by thermal conduction through a rod of copper or aluminum in the liquefied gas; in the third the liquid is siphoned out into an evaporating chamber, from which the gas is conducted through tubes—to bring it to air-temperature—to the airman's mouth, the rate of evaporation being controlled by adjusting the conical stopcock through which the gas is passed.

Liquid air is stored in spherical metallic vacuum vessels holding from 5 to 30 gallons, the high vacuum required being maintained by keeping absorbent charcoal, cooled to the temperature of the liquefied gas, in a chamber attached to the lowest part of the external wall of the inner vessel, whereby the annular space is highly exhausted. These vessels are durable, and the rate of loss from the largest does not exceed 5 per cent per day.

HOLIDAY GREETINGS

Compressed Air Magazine desires to wish for its subscribers throughout the world a Merry Christmas and a Happy New Year. Our solemn hope is that "Peace on Earth and Good Will Toward Men" may soon prevail industrially and politically in all lands.

COMPRESSED AIR MAGAZINE

Established in 1896

COMPRESSED AIR MAGAZINE CO., PUBLISHERS, EASTON, PA.

Devoted to all useful applications of compressed air and to everything pneumatic

NEW YORK: Editorial and Business Offices, Bowling Green Building, No. 11, Broadway.
Telephone: Bowling Green, 8430; Cable Address: "Compaire" N. Y., Western Union Code.
BRITISH ISLES: No. 165, Queen Victoria Street, London, E. C. 4.

VOL. XXIV, NO. XII *DECEMBER, 1919*

W. L. SAUNDERS, *Editor*

FRANK RICHARDS, *Technical Editor* FRANCIS JUDSON TIETSORT, *Managing Editor.*

CHARLES A. HIRSCHBERG, *Business Manager.*

Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

Subscription rates—Postage Included

The United States, American possessions and Mexico..........$3.00 the year
Dominion of Canada and other foreign countries..........3.50 the year

Single Copies—Twenty-five Cents.

NOTE—Subscribers will please notify the Circulation Department at once of change of address or in case of belated delivery or non-delivery.

GETTING DOWN TO BRASS TACKS WITH RADICALISM

WRITERS for the magazines, newspapers, and the trade periodical press, which latter should now be in a position to know better, have in the last six months printed countless articles and editorials respecting the causes of industrial unrest. In nine cases out of ten they have been wrong fundamentally, although expressing statements of lesser contributing causes.

The answer to the query, "What is the cause of industrial unrest in America when the people as a whole are enjoying a flood tide of prosperity?" lies in the records of the Department of Justice and in the Department of State at Washington. The subject is one on which we must speedily get down to brass tacks!

We are having revolutionary labor troubles beyond even the power of the more sober-minded labor leaders to control because we have been temporizing with and mollycoddling criminal foreign agitators seeking the "one great union," and universal revolution.

We have permitted class legislation for the selfish benefit of a class in this country and have encouraged thereby the idea promulgated openly and freely on street corners and in some 500 unsuppressed publications, that property rights and government by the people should be destroyed and all industry taken over by the gentle I. W. W. and other radical organizations.

Thus far, some 110,000,000 people in this country have been gazing at each other and asking the question, "What are you going to do about it?" and doing nothing. We have got to get past the stage where we saunter up to the edge of a crowd listening to a soap-boxer demanding that organized society be tumbled about our ears and that chaos be given free rein, and then slipping off without doing or saying something equally forceful.

This means that we must, by orderly processes of law, place moral and mental incendiaries beyond the power of wreaking their wild will upon the established institutions of the Grand Republic, the most successful and thriving example of free government in the history of nations, with the possible exception of that paradoxical "tight little isle' overseas from which sprang our potent political beginnings. We stand for and by the law. We are capable of upholding our place as a government and as a people through its work-

ings, for if we lack laws to govern a given situation we can certainly enact efficacious laws and penalties that will govern them.

We are a good-natured people, slow to mighty wrath, but when aroused we are capable of decisive action, as was noted in a general way in the late war, we believe. In the words of Senator Thomas of Colorado, "American citizens should awaken to the situation that confronts them. When this awakening comes, God help those who would send to destruction the great and mighty institutions of this country."

America will never permit "communism" or even an approach to it, but it will not do for the sane people of this land to sit by and ignore its mad dog proponents.

The I. W. W. has been largely responsible for the hundreds of strikes sweeping the country, actions by minorities of deluded men and women under the spell of skilled European propagandists sent here for purposes not unknown to our government. They want a single great union, which they contend would automatically start a revolution, with resultant seizure of all power and the running of the country for the benefit of the foreign group sent here for just that purpose.

Our appointed leaders and executives in government, industry and in all social life have the greatest, the most compelling duty of the times facing them, and the permitting of open plotting, of incendiary and destructive "free speech" and publication, is not a part of that duty.

We shall have to face a greater war and upheaval than that which shook Europe and the whole world to its foundations, unless we suppress, for all time in this republic, the possibility of class domination by methods similar to those employed by Germany when she surprised and shocked a world.

Richard H. Edmonds, editor of the *Manufacturers Record,* Baltimore, telegraphed to E. H. Gary, Chairman of the Board, U. S. Steel Corporation, declaring that arbitration with the Bolshevik "revolutionist" in this country would endanger our government and civilization itself. He made the statement that the night Trotzky left this country he called upon his followers in New York to remain here to "overthrow this dirty, rotten American Government," when the time came. Trotzky has many followers in America. Many of the leading spirits in the strikes throughout the country have been allied in principle and in fact with Trotzky. Radicalism run rampant now seeks to rule over the wreck of the American Government and the Constitution. The point is: Are the American people going to arbitrate *anything* with criminal foreign agitators and their ignorant dupes who are seeking to rend and destroy us?

FACTORIES SPRINGING UP IN FOREIGN COUNTRIES

ONE of the most disquieting effects of the high prices of American manufactured goods and the difficulty experienced by overseas merchants in obtaining deliveries is the stimulus given to the industrial development of countries which, but for the war, would have found it quite impossible to compete with the highly organized industries of the United States and Europe.

High prices, high freight rates, and lack of transport are likely to prove more potent aids to the establishment of manufacturing enterprises in the newer countries than a protective tariff with duties of 100% on imported goods. The difficulties of obtaining machinery and skilled labor, although great, are not insuperable.

In the opinion of the National Foreign Trade Council, a continuance of the present state of affairs will inevitably lead to the growth of manufacturing in many countries which have hitherto afforded large markets for our products, and this may involve serious changes in our export trade. In this connection, it is interesting to note that during the war many industries quite new to India arose to fill the void left by the stoppage of exports from Britain, and that many types of machinery and mechanical fittings are now being successfully manufactured there.

The Bengalee is a capable artisan when properly trained, and it is hardly necessary to add that his labor is not of the highly-paid variety. The development of a prosperous iron and steel industry in the Transvaal—where coal and iron ore in inexhaustible quantities exist in juxtaposition

—is already becoming practicable. In Australia, too, the manufacture of woolen goods is attracting increasing attention.

While such industrial development is bound to come to all countries possessed of the necessary raw materials, it is unfortunate that these markets should in any way be closed to American products at a time when a wide demand for manufactured goods is needed to ensure full employment to American industry. It would seem the part of wisdom to prevent further developments of this kind, whenever possible, by setting aside a definite percentage of factory output to supply to those countries in which manufacturing is not highly developed, the goods which they cannot do without.

THE FIRE OF INSPIRATION THAT HERALDS SUCCESS

A GREAT career of achievement has been known to develop from a moment of strong emotion which fired the spark of ambition to the point of accomplishment and which loosed the energy derived of true inspiration. The most highly accomplished artisan, or the genius we call an "artist" is one who not only originally felt a call for his vocation, no matter what his line of endeavor may be, but who worked tirelessly to perfect himself and in whose responsive soul fire was finally struck.

We call to mind a case in point that may possibly serve as an encouragement to the engineer wrestling with a problem, to the struggling inventor, to the mechanic invested with puzzling obstacles, to the executive pressed for solutions that seem remote, if not impossible. The story to which we refer is no whit less applicable in its lesson to men of practical affairs because the subject character chanced to have been a musician.

A young lady of Chicago who was a student of the violin in the Conservatory of Music at Berlin in 1906, had as a friend a woman singer also studying at the time under a private professor. The singer advised the violinist, naturally a most accomplished musician, but inclined to shirk her practice, that harder work would be required of her if she was ever to become a great violinist. One day the singer, who tells the story, insisted on accompanying the violinist to the studio of the latter's professor, so that she might hear the young Chicagoan's lesson.

The professor suddenly stopped the playing of his pupil and began to storm in the temperamental way of many great musicians, and he himself, it chanced, was a truly great musician whose name has been blazoned over the world.

"It is a pity," he exclaimed. "My dear Miss ———, you are highly talented with the violin but you are lacking in something. You play coldly, as though detached from your instrument. Your mind is not ardently on your work and furthermore you show a lack of intense practice and detailed study. You will never succeed unless there is a change. You will excuse me for being so frank, but the time has come when I cannot refrain from speaking plainly."

The young woman from Chicago showed signs of indignation through the tears that came to her eyes. No one had ever talked to her in exactly that fashion before, although her friend, the singer, had conveyed the same idea in less direct language. The professor relented to the extent of relating for her comfort his own experience.

"My own *maestro* finally turned me out," said the professor, "as what he called his finished product. He told me I was a genius and that he could do no more for me. 'You have wonderful technique,' he declared. 'Your style is superb. You have finish. In fact, you are a genius, but you are *not an artist*. You lack something.'

"I asked the *maestro* what it was I lacked, and he replied: 'It would do you no good for me to tell you. You must find it for yourself.' I was then preparing for my debut concert, and the words of the professor made a deep impression upon me. I worried greatly over the matter. Everywhere, in libraries, in concert and music halls I searched for the element I lacked. I worked for six months, as I never had worked before, in preparation for my debut, but I was afraid in my heart that I should not make the success for which I craved.

"I went back to my *maestro* and begged him to tell me what it was I lacked. He was adamant. 'My dear boy,' said he, 'you must find it for yourself. You have developed to the point of greatest

technical excellence, but the artist is still absent. Go and seek—you may find yet what you lack.'

"So, nearly distracted, I set forth again upon my final preparations for my first concert. One evening I was passing through a street near my lodgings and I saw a crowd collected. I pushed my way through and saw a little girl of twelve, bare of leg and foot, standing on a box. She was playing a violin made of a cigar box and she was drawing from it wonderful tones. I was thunderstruck for the moment and could scarcely think clearly.

" 'Here at last,' I said to myself, 'I have found in a little girl what I myself seek.' I pressed close to the girl and asked who she was and her story. She lived in an alley nearby. Her father, who had been a violinist, had died, and she was playing on the streets to earn money for her invalid mother and her little brother.

"Breathlessly I told her who I was. I would make her my *protege*. I would teach her—make her an *artiste*. I bade her come to my studio daily. At last my chance had come! I gave myself to the task. The delighted child rapidly responded to my efforts. I adopted her almost as my own child. She became very dear to me.

"Finally came the night of my debut. I was hopeful, but nervous. I had just gotten dressed in my evening attire and was giving the final touches before the mirror, when a telegram came to my door. I opened it, thinking first it was a word of encouragement from some friend. Instead, it had a message from the poor mother of my little pupil, telling me that she had been run over by a vehicle, that she was in a dying condition in a hospital, and was asking to see me. Would I please hurry to her.

"Agitated, I seized my violin case and raced off to the hospital. One look showed me my little friend was dying. Weeping, I kissed her good bye while she clung to my hand and told me with her last whispers that I must now hurry to my concert, which she was on her way to hear when struck down in the street, and that I should make a great success.

"We, the grief-stricken mother and myself, pulled the white sheet up over the delicate hands and drawn face of her little form. Time was short before my concert and I hastened away.

"Straight to the platform I went. I saw nothing, saw no soul in the audience, was oblivious to all but that which was in my soul. I played that night as I never before had played in my life. Every note was a prayer in my heart. Finally it was over. The audience was in a tumult. Flowers were hurled at my feet. I picked up a bunch of violets and bedewed them with tears. Friends and strangers alike rushed forward. I stood in the center of the stage as though dazed. I felt a kindly pressure on my shoulder and turned to look into the brimming eyes of my professor.

"You have found it! You are an artist my boy! *Now* you are an artist."

The professor of the young Chicago lady who told the story depicting the difference between being a "genius" and an artist was the great EUGEN YSAYE! The great YSAYE who always plays with head bowed down over his violin, one curly lock hanging over his forehead, oblivious to his surroundings—the great YSAYE who sleeps with his Stradivarius beside him, a violin that speaks to him!

This true story, here told publicly for the first time, has seemed to us worthy of the telling, because of the fact that artistry lies not only in execution, but in the feeling, the inspiration that accompanies it. The humblest may become a great artist in his calling—if the fire is within him!

LIFE IN BUSINESS MEANS—KEEP PROGRESSING!

AN ERUPTION in a large business concern, sometime ago, resulted in the "big man" leaving the organization. Before many hours had elapsed some of the stockholders and a great many of the townspeople began to express weighty opinions regarding how much it would injure the concern, and whether or not it could hold up under the handicap which the loss of this man would entail. Several men holding lesser positions with the concern, began immediately to speculate as to whom the tremendous responsibilities and work would fall upon. Some of them had been waiting for years—simply waiting—to step into his shoes, or at least part of them.

The man himself, who for so long had carried on bravely under the consciousness of his responsibilities, now wonders over the fact that they have gotten along without him. It may be inferred from this that perhaps, after all, he was not really their "big man"—which points out the moral that those who wait for dead men's shoes may at last get them—after they are worn out!

The man who "doped out" the expressions about everything coming to him who waits, being a good waiter, etc., did not realize that the law of progression is growth. He who would gain must get; he who waits rusts. Even the shellfish furnishes an example: When its stony case no longer permits of growth it crawls out and seeks a new place. So must men who would grow leave places, persons and things when their environment prohibits greater enlargement and development.

It is fatal to linger in the ruins of the old shack, which once provided bread and shelter, even though the sentiment is strong. The law of getting ahead is "Keep going upward and onward always."

Don't let your worldly relations cling too closely about you. Don't let them bind you to a place that offers no opportunity. But, when determining this question of opportunity be sure not to blindfold yourself to the possibilities that might exist, or be caused to exist through real effort on your part; and don't expect things to come your way just because you want them to. Do your best. Then, if all efforts fail, don't linger; throw off the dead circumstances and renew your efforts in a new place. Life means progression.

MR. FORD EVOLVES POWER PLANT UNIT FOR STREET CARS

HENRY FORD of automobile, tractor and Eagle boat fame, has completed and tested to his satisfaction an internal combustion engine for the economical propulsion of street cars at high speed. The first try out of the engine took place in the Ford experimental shops at Dearborn, Mich., and both Mr. Ford and his general manager, Mr. C. E. Sorensen, expressed themselves as being pleased with the outcome. Mr. Ford declared that he was convinced the motor would make possible both cheaper and faster urban transportation of passengers.

At the time we write the plans are to send one of these Ford street cars over the rails of the Michigan Central division of the New York Central Lines at seventy miles an hour as a pace-maker ahead of the *Wolverine* flyer, a fast train that runs between Chicago, Detroit and New York. The Michigan Central enjoys a splendidly maintained right of way. The idea will be to have a contest for a time record between the fast, light street car and the swift but heavy steel train propelled by a big compound steam locomotive. This test will soon be made.

The rail transportation world, we surmise, will be keenly interested in this experiment. Self contained power units for urban and inter-urban cars have long been desired for certain classes of transportation. Local traffic in passengers, express matter and mails could be established on frequent-trip schedules between many rail points in this country with such equipment if the service were sufficiently economical of maintenance.

The Ford car power unit is described as being a motor, an air compressor, an electrical generator, and a heating and lighting plant combined. All operations necessary for the control of the car are centred in the motor. A 75 per cent. reduction in weight, as compared with the power and control equipment of the ordinary electric car, is claimed.

Several cities, which have street railway problems, have invited Mr. Ford to demonstrate the cars on their streets. A feature which will appeal to cities which have hilly streets is the hill climbing power of the car. It can ascend a three per cent. grade at twenty miles an hour "on high."

EXIT THE OLD OAKEN BUCKET

THE OLD oaken bucket that hung in the well may be dear to the heart, but it's dangerous to the system.

The time honored well sweep and windlass were one of the picturesque features of the typical Polish landscape—until Polish and American Red Cross sanitarians at the head of the Polish public health work decreed that health was more import-

ant than landscapes. Though the bubbling spring by the roadside sounds well in poetry and the maiden drawing water from an old fashioned well is pretty in pictures, every open well is a potential epidemic breeder. With typhus and cholera raging throughout Poland, these wells are considered by the health authorities a direct means of contagion, exposed as they are to all sorts of contamination.

The American Red Cross health experts, who are coöperating with the native government in formulating a permanent health program, have discovered substitutes for the old wells. In the supplies abandoned by the Germans when they were forced to quit the country were found hundreds of pump connections, suction joints and valves in salvage warehouses. These will be used in addition to the modern wells which the Americans are constructing in several towns.

AMERICAN MNFRS. EXPORT ASSN. WOULD AID EUROPE

The American Manufacturers Export Association at its annual convention held at the Waldorf-Astoria hotel, New York, heard several addresses from men of national prominence, and a plea from the French High Commissioner, Mr. Casanave, all outlining the need of extending vast credits to European countries.

The retiring Secretary of Commerce, Mr. William C. Redfield, who is now engaged in business in New York, suggested a practical plan of establishing a powerful corporation with a capital up to a billion dollars, and having the moral support of the government, which should extend credits abroad to governments and all manner of business enterprises, and which should issue its own debentures, in large and in small denominations, so they might be popular investments.

His idea was that there should be a nation-wide selling campaign for these bonds on the lines of the various Liberty Loans, and that the funds thus easily to be raised, should be utilized in this great international business venture to restore European credits and industry, stabilize exchange, renew European industries and enable them to pay their war debts. This would ward off the catastrophe feared by all the speakers touching on the subject. Mr. Frank A. Vanderlip renewed his assertions of the early summer on the exceeding gravity of European conditions, and said that all of the European countries excepting Belgium were in worse case than they had been at the beginning of this year.

Mr. W. L. Saunders, Chairman of the Board of the Ingersoll-Rand Company, and Editor of *Compressed Air Magazine,* was chosen as the new President of the Association, presiding at the annual dinner. He paid a tribute to the work of his predecessor, Mr. George Ed Smith, president of the Royal Typewriter Co., in whose two years of office the Association had doubled in membership.

The Association went on record with the belief that American manufacturers should resume trade with the Central Powers as their individual interests might dictate, but that in allocating output and extending credit they should more particularly favor the countries with which we were associated in the war. Other points made in resolutions passed, were:

That the Senate take early action on the peace treaty.

That official support be given in the form of economic assistance and generous credit facilities to the efforts of patriotic Russians who are endeavoring to create a united and constituent country.

That the necessary machinery for improving and stabilizing foreign exchange should be immediately provided.

That steps be taken to improve the consular and diplomatic service.

That we should assist in the rehabilitation of Europe to the full extent of our ability.

That American manufacturers should take advantage of their present freedom from competition to resume their domestic development.

That to accomplish the desired results labor, for its part, should increase its productive effort as the only possible means of maintaining the present standards of living.

Among the principal speakers at this year's sessions and at the annual dinner, not previously mentioned, were: Louis E. Pierson, Gilbert H. Montague, Frank D. Waterman, Martin W. Littleton, W. L. Saunders, William Phillips, Hickman Price, Allen Walker, C. Lyon Chandler, C. Barthel de Weydenthal, Edmund A. Walsh, Alexander Zelenko, William Graves Sharp, M. A. Oudin, Louis E. Van Norman, Joseph M. Goldstein, Lewis Heck, W. C. Huntington, Lawrence Langner, Frederick M. Corse, W. W. Nichols, W. S. Gavan, Phil Norton, Aco Despitch, Eugene Schneider, Alonzo G. Taylor, Alba B. Johnson, Senator Owen, Colonel Faunthorpe.

James J. Converse, of New York, formerly Acting Secretary of the United States Shipping Board, left recently for an extended tour throughout Poland and other parts of Europe to survey the opportunities for the use of American banking facilities there and to lay the foundation for ship transactions between American shipbuilders and foreign purchasers. Mr. Converse accompanied Constantine Radkieweitz, one time general manager of the Vistula Navigation Company, who came to this country to buy boats for Poland.

Personal Intelligence

The Interborough Rapid Transit Company of New York, operating the subways and elevated lines of New York, has elected Mr. Frank Hedley as president and general manager to succeed the late Mr. Theodore P. Shonts. One of Mr. Hedley's first acts was to summon representatives of the New York dailies and announce that henceforth there would be no secrets from the public in the administration of the system, inasmuch as it was owned jointly by the city and private interests. He recommended "flexible fares" of from eight to ten cents, and that the city should set aside a fund from the increased fares to purchase the properties entire. He made a plea for a fair rate of profit, under the existing conditions, on the money invested by both the city and the company.

* * * *

A. A. Schneider has been appointed manager of the new raw-materials division of the American Steel Export Co., to handle imports, exports, and domestic sales of pig iron, ores, and ferro alloys. He was formerly with the raw-materials department of the Midvale Steel & Ordnance Co. and the Cambria Steel Co.

* * * *

R. W. Creuzbaur, after two years with the Emergency Fleet Corporation, as consulting engineer, has resumed private practice in his New York office. His work with the government was as consulting engineer in direct charge of the three plants at Hog Island, Bristol, Pa., and Newark, N. J.

* * * *

Walter Clark has been elected president of the recently incorporated Liberty Engineering & Construction Co., Murchison National Bank building, Wilmington, Del. The other officials include E. L. Phillips, J. A. Page and H. W. Nutt.

* * * *

Southern Engineering Co., New Orleans, has been organized by C. P. and W. H. Davidson, who were recently released from military service with the U. S. Army. As manufacturer's agents they represent the Buffalo Forge Co., the Buffalo Steam Pump Co., the Schütte & Koerting Co., the Steam Motors Co., the Erie Engine Works and the Corrugated Bar Co. C. P. Davidson formerly was with the Raymond Concrete Pile Co., and W. H. Davidson with Stone & Webster.

* * * *

Horace G. Cooke, who has withdrawn from the Connersville Blower Co., after twenty years of service as eastern representative, has announced the organization of Horace G. Cooke, Inc., to engage in designing and marketing a complete line of rotary compressors, gas exhausters and pumps for the National Marine Engine Works, Inc. The executive and sales offices will be located at 50 East 42d street, New York City.

* * * *

A mineralogist of Tokyo, Japan, Mr. C. Matsurbara, has been a visitor in the United States in recent months, making special inquiries into the state of mining conditions in the Rocky Mountain region.

* * * *

George T. Castleton of Eureka, Utah, an assayer, is up for membership in the American Institute of Mining and Metallurgical Engineers.

* * * *

C. W. Cross has been appointed as manager of western railroad sales by the Chicago Pneumatic Tool Company, with headquarters in the Fisher Building, Chicago.

* * * *

Henry P. Flint, mill superintendent for the Tom Reed Gold Mining Company, of Oatman, Nevada, perished recently while endeavoring to rescue his daughter from drowning, the latter being saved.

* * * *

James W. Burnham, discoverer of the famous "Queen of the Hills" mine in Dry Canyon, near Ophir, Utah, and connected with the mining industry for nearly half a century, was found dead in his bed at the property of the Southern Pacific Gold & Copper Mining Company, at North Ogden, Utah, of which company he was vice president and superintendent.

* * * *

Morris P. Kirk, manager of the Yellowpine Mining Company, Goodsprings, Nevada, has entirely re-equipped that property, both as to mine and mill, and operations are reported by Mr. Kirk as progressing satisfactorily. The mine is known as a regular producer and dividend-payer.

* * * *

Clayton S. Cooper, editorial director for Messrs. W. R. Grace & Co., New York, was the author of a recent article in the columns of the New York *Sun* in which he told how some Yankee business methods were a great puzzle to the skilled Latin-American traders. He related how one South American dealer who ordered hardware received a cargo of coffins.

* * * *

"American Company Shop Committee Plans," a digest of twenty plans for employees' representation through joint committees, is a pamphlet that is of especial value today when exact knowledge of such plans is essential. Bureau of Industrial Research, 289 Fourth Ave., New York. $1.00.

Books and Writers

EMPLOYMENT MANAGEMENT, compiled and edited by Daniel Bloomfield, with an introduction by Meyer Bloomfield, partners of Messrs. Bloomfield & Bloomfield, of Boston. Price, $1.80. New York: The H. W. Wilson Company.

MESSRS. BLOOMFIELD have collected for presentation to employers the best material available on the new subject of employment management, a phrase unknown a decade ago, their compilations and comment thereon comprising a handbook for ready reference. Students of the subject at the various universities will find this a valuable and convenient work. It will be of especial usefulness to industrial executives that are interested in the human problems of management.

In addition to reprints of pertinent material, a selected bibliography is included, together with an appendix containing examples of important forms used in a well-organized employment department of a business. The very title of the book indicates that it is significant of the moment, for one may ransack the literature of as late as ten years ago on the subject of industrial management, but find no reference to "employment management." No college or university school of business training of that day dealt with the problem. Mr. Meyer Bloomfield observes that this does not imply that industrial managers were unaware of what a sound plan of personnel organization meant to industry, for even eight years before the United States entered the world war, with its requirements for high industrial efficiency, there were executives in this country imbued with an understanding that there was a new function developing in business administration, and who were already taking steps to put into practice their perception of this new function.

It has now become a highly essential part of management as a whole, for obvious reasons, and a true understanding of the principles of employment management is proving of great benefit both to the employed and the employer. Unlike many another pioneer idea it has not been obliged to fight its way, but has received ready recognition and welcome.

And here is a point to which the experts call attention and where they sound a note of warning. Standards are not yet all they should be, and vision, fitness and good sense are sometimes missing. There are at least today certain standards by which to measure and criticize and improvements in this important function are bound to come. The book we are discussing will be helpful in the forming of a sound judgment, for its general outlook is sane. We are glad to commend it to all concerned with these pressing problems of employment and we know few industrians in any capacity that are not concerned.

ELECTRICAL GOODS IN ARGENTINA, URUGUAY AND BRAZIL, by Philip S. Smith, Trade Commissioner of the Department of Commerce. Price, 20 cents. Washington: Superintendent of Documents, Government Printing Office.

A MOST promising future for American electrical goods exists in Argentina, Brazil, and Uruguay, according to a report just made to the Bureau of Foreign and Domestic Commerce, Department of Commerce, by Trade Commissioner Philip S. Smith. The use of electricity is widespread in all three countries. The Trade Commissioner's report is a detailed guide published for the benefit of the American manufacturer who wants to make the most of his opportunities in Latin America.

In Argentina and Uruguay the high cost of imported fuel and the lack of water power limit the use of electrity to some extent, but in Brazil the immense amount of water power available makes the electrical field a peculiarly attractive one to manufacturers of electrical equipment. As this water power is found for the most part in the coastal section of the country, it will be available for industrial enterprises and for general lighting, heating, and power purposes in the numerous cities of this section, which includes the greater part of the population of the country.

American materials were not a very important factor in Argentina before the war, but have become decidedly so since hostilities began, the report says. The problem there is to maintain this advantage when the old competition returns. In Brazil, American electrical supplies have always been favored above all others, owing principally to the fact the power plants in the large cities use American materials almost exclusively. Germany's share in the trade, however, was increasing steadily up to the time the war started, and since that time Japanese materials have appeared on the market, although not in large quantities.

THE HOUSING OF THE UNSKILLED WAGE EARNER, America's Next Problem, by Edith Elmer Wood. With Appendix and Index. Price, $2.25 net. New York: The Macmillian Company.

THIS NEW and timely volume, just issued by the Macmillan Company, is the result of careful studies by Mrs. Wood, who enjoyed the advantage of consulting the files of the National Housing Association, and who delved into the history of her subject from days antedating the activities of the late Mr. Jacob Riis of New York, who did so much to stir the consciences of some

landlords and was responsible for legislation that forced others to mend their ways.

Mrs. Wood gives a clear and thorough account of the housing problem from various points of view. She discusses the steps in the past which have been made in New York and in other cities, as well as in the United States as a whole. Large industrial corporations and communities that are confronted with housing perplexities, (and where are there not such serious questions to be faced in America today?) should not fail to obtain and study this volume.

The author presents the restrictive legislation that has been adopted and she also takes up the various philanthropic schemes and those of private corporations that have built model dwellings. Her main argument is that the general problem is one which is clearly up to the community, and that it has become a social duty to make sure that the dwellings of even the poorest citizens are clean and wholesome.

The Westinghouse Electric, the Ingersoll-Rand Co., the United States Steel, and scores of our largest industrial corporations have taken important steps in the matter of providing at low cost, for rental or purchase, modern sanitary and comfortable homes for their employees and their experiences in making the worker happy have shown that it pays. Here lies one means of fighting radicalism.

THE CIVIL ENGINEER'S POCKET-BOOK, by John C. Trautwine. Revised by John C. Trautwine, Jr. and John C. Trautwine, 3d. Twentieth edition, first issue, 1919. 4¼x6¾"; xxvi-1576 pps, including 350 new pages and 1250 illustrations. Gilt edges, thum indexed. Price, $6. Philadelphia: The Trautwine Company. London: Chapman œ Hall, Ltd.

THE TRAUTWINE handbook for civil engineers has been a familiar reference book these many years, its first issue having made its appearance in 1872, but the present issue for 1919 is by long odds the most complete and the foremost work of the sort published in the English language, or for that matter, in any other language. The scope it covers is too well known to engineers to require specific comment here, but it is worth noting that with the printing of the 140th thousand, additions and revisions have been made that place it in the indispensable class.

Great improvements have been made in the textual matter applying to railroads and four times as many pages are now devoted to the subject. Throughout the work great pains have evidently been exercised to guard against typographical and other errors.

We grieve to note the intense modernity of this work in its spelling. While it will rejoice the hearts of the reformers, so-called, who juggle with accepted English orthography, our own old-fashioned eye is repelled with: "such distinction promist increast clearness"; "thoroly checkt"; "altho," etc., which will likewise shock the sensibilities of many old-time Trautwine adherants. F. J. T.

There has just fallen into our hands a multigraphed booklet issued by the Chamber of Commerce of Portland, Oregon, entitled, "General Survey of the Columbia River Gateway Country," showing the industrial, shipping, agricultural and general business conditions and opportunities in the Pacific Northwest. The report also shows meteorological data of interest. The book is filled with charts and maps and statistics as to ports and other cities that will be of value to manufacturers considering the establishment of branch factories on the Pacific Coast. Existing industries, which are varied and important, notably lumbering and shipbuilding, are the subjects of general description.

The efficiency magazine known as *100%* published at Chciago, has built up in its six years of life a constituency of 30,000 subscribers, and is publishing every month practical ideas that serve as a guide and inspiration to business men. A recent issue of this miniature, but prosperous publication, contained articles showing why hour costs are better than those on a per thousand basis; what the Plumb plan means; what is causing industrial unrest; a description of the industrial relations plan put into effect by the Goodyear Tire and Rubber Co. of Akron, Ohio; and an article describing the application of general principles of proper management control to one's business. *100%* appeals to us as a periodical every up-to-date man of business should have on his desk or in his pocket, for it will fit there. It stimulates thought and action.

It is stated in the *Journal of the Society of Automotive Engineers* that a record of 99 per cent was made by the Air Mail Service between Washington and New York for the month of June. The total mileage covered was 11,118, and the total weight of mail carried 15,643 pounds. On the Cleveland-Chicago division, a perfect score of 100 per cent was obtained. In this division, the total mileage was 19,825 miles, and the weight of the mail carried 19,603 pounds. The average speed on that route for the month was 97.8 miles per hour. The operation of the Cleveland-Chicago route is without parallel in the history of aviation. Since May 15, seventy consecutive daily non-stop flights of 325 miles each were made without a forced landing.

Buenos Aires

The First Air Compressor

THIS COMPRESSOR IS A BIT OVERHEATED. THE DRAWING BY BUNNY FROM LIFE* EXPLAINS THE SITUATION. AT TIMES THIS MECHANISM ACTS AS A VACUUM PUMP. A LOW ECONOMY MACHINE.

Not still life.

Excuse cuss words and slang, but we are obliged to put both into the chaste type of this column when we reproduce L. R. Bates' worth-while verses, "The Heater Boy," from *The California Shipbuilder*:

I'm a "tough guy," people say,
  But I'm damn sure I ain't.
Of course I have a kind of way
  That won't just suit a saint;
But bring me any saint you want
  As soft and white as snow,
Within a week he'll be as tough
  As any guy I know.

Just have him stand one single day
  Before this rivet fire.
A-tossin' red hot rivets ain't
  Like singing in a choir.
Besides there's that damn holder-on
  Who thinks he's learned to curse.
Well, you should hear the riveter.
  By God, he's ten times worse!

Yes, I guess I'm tough all right.
  But you just take my place,
And keeping the rivets blazing hot
  All day; it's no soft race.
And don't set fire to the hose
  Or throw the rivets wrong,
Or hit the inspector in the face.
  It means "good night;" you're gone.

Do you think I like being heater-boy
  Down in a mad-house hold,
With riveters driving a man to drink
  And no danger of catching cold?
But somebody's got to tackle the job,
  And I guess that somebody's me.
I'm sorry if I'm so damned hard-boiled,
  But somebody's got to be!
  (Putting up ships like me)!

It is truly remarkable what a printer, backed with sufficient credit, can make of paper. A writer in the periodical *Steam* comments on how a certain banker paid the U. S. Government $500,000 for thirty pounds of paper. The stock was delivered in sheets about 3x8—and there were only 500 sheets. They were printed in two colors with the statement on each sheet that it would be exchanged by the Government for $1,000 in gold. The banker did not take the paper for redemption to the Government. He exchanged it with several different business men for a fully equipped paper mill. The mill manufactured the same kind of paper which the Government sold for $16,666 per pound, and offered it for forty-five cents per pound unprinted.

SEZ UNCLE SAM

By RUFUS T. STROHM

In *The Coal Age*

"A lot of folks has got the blues
From readin' in the daily news
That every week, ships sailin' east
Take back two thousand men, at least,
That used to labor in our mines
An' help to build our railroad lines;
But as fer me, I'm cool an' ca'm,"
  Sez Uncle Sam.

"These fellers don't belong to me,
An' more than that, the country's free;
So when a workman trails his nose,
It's no one's bizness where he goes;
Besides, ef these dubs sail away
Because they hate the U. S. A.,
I'd say that I'm in luck, by damn!"
  Sez Uncle Sam.

"Ef they jes' hanker to git back
Among the ruin an' the wrack,
Where death goes stalkin' to an' fro
In hand with famine—let 'em go!
I hope they git a stomachful
Of all this socialistic bull,
An' anarchy ad nauseam,"
  Sez Uncle Sam.

"Then, mebby, when they're good an' sick
Of places run by Bolshevik,
They'll want to come back here again
To live with honest, decent men;
Well, then, perhaps they may git by—
Ef I've not raised the bars too high!
That's jes' the sort of guy I am,"
  Sez Uncle Sam.

Bunny entered our sanctum, where we enjoy the privacy of a gold fish, to inquire whether the new trade publication called *Raw Material* is to be classed with *Snappy Stories*. It is with mingled satisfaction and pain that we record the fact that he was promptly thrown out by manly and boisterous persons who were able, unhappily, to overhear his query.

The Marquisian philosopher, poet and humorist of the New York *Evening Sun* declares that perhaps it's not surprising that an aviator found a pocket of hot air at an extreme altitude, for enough of it has been emitted to warm up interstellar space. Fact, but the assertion is too general, and therefore hot-airish. And not all of it is furnished by the politicians. Newspapers have been known to release quantities, though we wouldn't go so far as to say that a colyum conductor, like ourself, as it were, could be accused

of warming the upper airs. Anyway, emitting figments of the imagination, so to speak, is not necessarily to be classified as the heating of air. To be exact, what the aviator struck in his journey was a pocket of exhaust from Ingersoll-Rand compressors, says Bunny of that well known company.

THE ENGLISH

By GRACE AGNES TIMMERMAN

In *The New York Times*

Pent in a sea-girt isle, theirs is the soul of the sea—
Dominant, strong and deep; steady and grave and free.
Though the murk of their misty skies
May often dim their eyes,
They can see to fight in the blackest night
For the cause of Liberty.

Well for the weal of the world that their will holds like the rock!
Well for our land at ease when they bore the battle shock!
Ah, we who dwell in the sun,
Where the mingling rivers run,
May serve our race with a lighter grace,
Yet boast of our parent stock.

Summed by a critic eye, their faults and their failings mount;
(Even may be the score with ours, in the long account!)
But they bear the Word of God
Wherever their foot has trod,
And they teach the weak of the world to seek
For wisdom at the fount.

Liberty laughed one day, with Magna Charta sealed.
Craving the whole wide earth, she claimed her an English field;
And she ruled there from that day
With a wider, wider sway,
And her light shone out on the lands about,
And the world's hope was revealed.

Legion have been her foes, folly and greed and pride,
Hunger of pomp and power, and a hundred things beside.
But the English, even as we,
Have striven to be free;
If they scorn one thing, 'tis the headstrong King
Who drove us from their side;

Taught by his wild mistake, they have learned their lesson well.
Ask if their rule be light! Their colonies will tell.
Ask if their cause be loved!
Africa even has proved!
Then cast one glance on the fields of France
Where the slaughtered Anzacs fell!

That which we love, they love; that which they hate, we hate.
Weak was the riven tie, but strong is the bond of fate,
And it binds us each to each
With a tie of common speech,
And our common ward, where we stand on guard,
O'er Freedom's vast estate!

PHILOSOPHY AND FOOLISHNESS

There must be something in spiritualism; mediums always seem to have money.

Most folk don't seem to care about becoming angels as long as they can make a good living here.

Some actresses wear plenty of smart clothes to attract attention and cause comment; others go to the other extreme to accomplish the same thing.

When a chap gets to the point where he is satisfied with himself a new entry is made for him in the register of chumps.

A woman who cannot forgive should not become too well acquainted with even the best of men.

If men were all as good as they seem, and women all as good as they look, our churches and uplift societies would go out of business.

The Skeptic.

Rules for Well-Run Offices

1—Conserve air by eliminating unnecessary conversation.

2—Save shoe leather by remaining on the job at your desk. Were you hired to act as a floor walker?

3—During the war we had wheatless and meatless days. Let us now have feetless days, at least as far as the tops of desks are concerned.

4—If you feel that it is absolutely requisite that you reflect your high spirits by whistling or singing, make the tune "Deutschland uber Alles" so that the rest of the office force will have an excuse for dropping a typewriter on your dome.

BAWMIE INTHEBEAN.

CONFIDENTIAL EMPLOYMENT BUREAU

NOTE—Advertisements under either of the classifications below will be numbered in the order of receipt and published free of charge, for the benefit of readers, in the next issue after date. All applications for the use of this convenience should be directed, "Confidential Employment Bureau," Compressed Air Magazine, Bowling Green Building, New York City. Replies to advertisements will be forwarded to the person or persons concerned.

HELP WANTED.

No. 436—Engineer wanted for power plant in southern Wisconsin. Three Stirling boilers, chain grates, 750-kw. turbine, Corliss engine. Must be thoroughly experienced and possessed of self-reliance.

No. 437—Experienced foreman required for manufacturer of general hardware. Location in New England, small but up-to-date plant. State fully age, experience and salary wanted.

No. 438—A production manager is sought by a foundry equipped with all modern foundry appliances. Location, Michigan. Attractive surroundings and right pay.

No. 439—First class pattern maker required. Married man preferred with jobbing shop experience. Steady work for the right man. Location, Texas. Give full information in first letter.

No. 440—Large structural steel plant desires foreman for fabricating department. Must be especially familiar with fabricating of bridge and building. Middle age man preferred.

POSITIONS WANTED.

No. 865—Position wanted either as mining superintendent or assistant by experienced man. At present time connected with a Lake Superior copper mining company. Full information will be given in first letter.

No. 866—Experienced draftsman open for position. Thoroughly capable of laying out work and checking. At present employed.

No. 867—All round foundry superintendent familiar with both heavy and light work open for position. Willing to take an interest in the business.

No. 868—Man thoroughly familiar with malleable iron foundry work open for position as superintendent. Can produce results. At present connected with a going concern.

No. 869—Position wanted by boiler shop foreman who knows how to handle men, and capable of taking complete charge of fabricating and erection. Twenty years' experience with a large eastern steam boiler manufacturer. Eastern location preferred.

Latest U. S. Patents

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

SEPTEMBER 16

1,316,468. FLUID-PRESSURE PUMP. Howard W. Truscott, Jennings Lodge, Oreg.
1,316,469. COMBINED PNEUMATIC MATTRESS AND GARMENT. Ray Werner, San Francisco, Calif.
1,316,507. SAND AND GRAVEL PUMP. Jesse A. Pollard, Oakland, Miss.

1. A sand and gravel pumping outfit comprising a casing adapted to be sunk into the earth until the lower end thereof is projecting into the sand and gravel bed, said lower end being open, a sand pipe open at the lower end positioned in the casing, means for maintaining a certain water level in said casing, an air pipe extending through the upper part of the casing to near the bottom of said casing, said air pipe being connected with the sand and gravel pipe near the bottom of the sand and gravel pipe, a swinging discharge pipe connected with the upper end of said pipe, means acting as a container for receiving water and sand from said discharge pipe, guiding the water to said casing, and a gate for controlling the water as it passes into said casing from said container.

SEPTEMBER 23

1,316,666. MOLDING-MACHINE. Arthur D. Ziebarth, Davenport, Iowa, and Albert V. Magnuson, Berwyn, Ill.
1,316,684. PNEUMATIC STRAW-STACKER. Frank B. Carter, Indianapolis, Ind.
1,316,745. APPARATUS FOR REMOVING PAINT FUMES. Lewis A. Safford, Buffalo, N. Y.
1,316,754. FUEL AND AIR MIXING APPARATUS FOR INTERNAL-COMBUSTION MOTORS. Alexander Winton, Lakewood, Ohio.
1,316,883. AIR-PURIFIER. George C. Fatscher, Lakewood, Ohio.
1,316,937. AIR-BRUSH. Ernest B. Brewster, New York, N. Y.

SEPTEMBER 30.

1,317,235. PNEUMATIC MATTRESS. Charles H. Stonebridge, New York, N. Y.
1,317,308. APPARATUS FOR CONTROLLING THE PASSAGE OF CARS OR VEHICLES ALONG RAILWAYS. Frank H. Nicholson, Wilkinsburg, Pa.
1,317,362. HUMIDIFYING ATTACHMENT FOR GAS-ENGINES. Arthur A. Friestedt, Chicago, Ill.
1,317,363. EROSIVE-BLAST APPARATUS. Ferdinand G. Gasche, Chicago, Ill.
1,317,457. VACUUM-CLEANER. Jeffrey J. Power, Madison, Wis.
1,317,529. SAFETY CAR-CONTROL EQUIPMENT. Walter V. Turner, Wilkinsburg, Pa.
1,317,549. CAR - DOOR - CONTROLLING DEVICE. Christopher P. Cass, Maplewood, Mo.
1,317,638. BLOWPIPE. George F. Naab, Lakewood, and Henry Prell, East Cleveland, Ohio.

OCTOBER 7.

1,317,705. METHOD OF FIXATION OF ATMOSPHERIC NITROGEN. James S. Island, Hamilton, Ontario, Canada.
1,317,809. SAND-BLAST MACHINE. Charles F. Motz, Monaca, Pa.
1,317,827. HIGH-SPEED-GLASS-DELIVERY APPARATUS. Alexander L. Schram, Hillsboro, Ill.
1,317,857. LIFTING-JACK. James B. Bristow, Monroe City, Mo.
1,317,874. FLUID-OPERATED PERCUSSIVE DRILL. Harry V. Haight, Sherbrooke, Quebec, Canada.
1,317,955. PNEUMATIC REGULATOR FOR ENGINE-GOVERNORS. Alexander E. Cameron, Providence, R. I., and Robert S. Riley, Worcester, Mass.
1,317,959. FROST-PREVENTER FOR ORCHARDS, Etc. Edward S. Cobb, Whittier, Calif.

8. Plantation protecting apparatus of the character described, embodying a vertical stack of a height greater than the plantings to be protected, means for mechanically positively forcing air upwardly through the stack, and means at the upper end of the stack to direct such air outwardly above the plantings to be protected.

1,317,989. ROTARY PUMP AND BLOWER. Lee H. Rogers, Kansas City, Mo.
1,318,307. FLUID-PRESSURE TURBINE. Oscar Anton Wiberg and Sigurd Mattias Backstrom, Finspong, Sweden.

OCTOBER 14.

1,318,350. GOVERNOR FOR PNEUMATIC PLAYER-ACTIONS. Theodore P. Brown, Worcester, Mass.
1,318,358. RIVET-FORGE. Lawrence Crawford, New York, N. Y.
1,318,375. DISTRIBUTER FOR COMMINUTED OR PULVERULENT FUEL. Daniel Goff, Millville, N. J.
1,318,565. DUST-BLOWING ATTACHMENT FOR HANDSAWS. James P. Johnson, Savannah, Ga.
1,318,605-6. APPARATUS FOR CHARGING HYDRO-PNEUMATIC RECUPERATORS OF GUNS WITH LIQUID AND GAS UNDER PRESSURE. Eugene Schneider, Le Creuzot, France.
1,318,617. ROCK-DRILL. William A. Smith, Denver, Colo.
1,318,704. CONNECTING-ROD AND TOGGLE FOR PNEUMATIC DRILLS, AIR-TOOLS, AND THE LIKE. Lewis Sykes, Camden, N. J.
1,318,773. AUTOMATIC MUSICAL INSTRUMENT. Rudolf Kuss, New York, N. Y.
1,318,834. COMPRESSED-FLUID DISTRIBUTER. Louis Bleriot, Suresnes, France.
1,318,863. PRESSURE-REGULATOR. William F. Gradolph, Toledo, Ohio.
1,318,874. ELECTROPNEUMATIC ACOUSTIC APPARATUS. Jurgen Sjoerd Hooghiemstra, Delft, Netherlands.
1,318,881. VACCUM-CLEANER. George C. Kelley, Hammond, Ind.
1,318,897. COMPRESSED-AIR STARTING AND REVERSING VALVE-GEAR FOR COMBUSTION-ENGINES. Thomas Forret Methven, Dalmuir, Scotland.
1,318,925. CONTROLLING MECHANISM FOR AIR-BRAKES. Thomas W. Scott and Harold V. Rudolph, Baltimore, Md.
1,319,022. FLUID-PRESSURE VALVE. Thomas L. Titus, Omaha, Nebr.

OCTOBER 21.

1,319,034. PNEUMATIC IMPLEMENT. Oliver O. App, New York, N. Y.
1,319,059. AIR-CLEANING MECHANISM. Truman B. Funk, Moline, Ill.
1,319,086. SHOCK-ABSORBER. George L. Jacques, Neillsville, Wis.
1,319,311. CAR, AIR, AND ELECTRIC COUPLING. Charles H. Tomlinson, Mansfield, Ohio.
1,319,572-3-4. AIR-FILTER. Vito di Sante, Wichita, Kans.
1,319,667. APPARATUS FOR AERATING LIQUID. Frederick B. Kollberg, Bisbee, Ariz., and Max Kraut, Los Angeles, Calif.

FIFTY SHIPS IN TEN MONTHS FROM HOG ISLAND

With the delivery of the *Nobles,* a 7800 d.w.t. freighter, the Hog Island Shipyard completed delivery of its first vessels to the United States Shipping Board. The total tonnage delivered is 391,250 d.w.t. This is the world's record for shipbuilding in a single yard.

The total tonnage delivered by the American International Shipbuilding Corporation (Hog Island Shipyard) is 105,705 d.w.t. greater than the deadweight tonnage of seagoing vessels delivered from American yards for the year 1916 which was the record pre-war year in ship production. In that year (1916) there were built in all yards in the United States 38 sea-going vessels of 1500 d.w.t. upwards, totaling 285,555 d.w.t.

CLASSIFIED BUYERS' GUIDE

Air Cylinder Oil.
Chicago Pneumatic Tool Co.

Air Lift Pumps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Air Receivers and Reheaters.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Stearns-Roger Mfg. Co.
Wm. B. Scaife & Sons Co.

Aftercoolers, Air.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Stearns-Roger Mfg. Co.

Air Jacks
Chicago Pneumatic Tool Co.

Belting.
Republic Rubber Co.

Blowers.
Cameron Stm. PumpWks.A.S.
Chicago Pneumatic Tool Co.

Blowing Engines.
Cooper Co., C. & G.
Ingersoll-Rand Co.

Catalogue Designers.
Jewett.

Channelers.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Charging Stations.
Porter Co., H. K.

Coal Cutters.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Compressors, Air and Gas.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Hartford Contr's. Supply Co.
Ingersoll-Rand Co.
Powell Co., Wm.
Stearns-Roger Mfg. Co.

Compressor Fittings, Air & Gas
Chicago Pneumatic Tool Co.
Powell Co., Wm.
Republic Rubber Co.

Compressors, Portable.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Compressor Regulators.
Chicago Pneumatic Tool Co.

Conveying Equipment.
Pangborn Corporation.

Core Drills, Diamondless.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Corliss Engines.
Cooper Co., C. & G.

Drill Chucks.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Drilling Machines, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Drill Sharpeners.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Drill Steel, Hollow and Solid.
Inter'l High Speed Steel Co.
Ingersoll-Rand Co.

Dust Exh.-Arrester Systems.
Pangborn Corporation.

Dust Handling Equipment.
Pangborn Corporation.

Drilling Stands.
Chicago Pneumatic Tool Co.

Electric Drills and Grinders.
Chicago Pneumatic Tool Co.

Electric Hammer Drill.
Chicago Pneumatic Tool Co.

Electro-Pneumatic Machinery.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Foundry Appliances.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Son Co.

Gas Engines.
Cooper Co., C. & G.
Hartford Contrs. Supply Co.

Gas, Gasoline and Oil Engines.
Chicago Pneumatic Tool Co.

Gaskets.
McCord Mfg. Co.

Hammer Drills.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Hammers, Calking & Chipping.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Hammers, Riveting.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Hoisting Machinery.
Lidgerwood Mfg. Co.

Hoists, Air.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Hose Coupling and Clamps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Hose, Steam and Air.
Chicago Pneumatic Tool Co.
Goodrich Rubber Co.,TheB.F.
Ingersoll-Rand Co.
Republic Rubber Co.
Stearns-Roger Mfg. Co.

Intercoolers.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Locomotives, Compressed Air.
Porter Co., H. K.

Lubricating Grease.
Keystone Lubricating Co.

Lubricating Oils.
Ingersoll-Rand Co.
Keystone Lubricating Co.

Lubricators.
McCord Mfg. Co.
Powell Co., Wm.

Meters, Air.
Ingersoll-Rand Co.
New Jersey Meter Co.

Mining Machinery.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Moister and Oil Separators.
Pangborn Corporation.

Motors, Air and Gas.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Motor Trucks & Ry. Motor Car
Chicago Pneumatic Tool Co.
Sprague Electric Works.

Oil Cups.
Powell Co., Wm.

Ore Concentrating Machinery.
Stearns-Roger Mfg. Co.

Photo-Engravers.
Jewett.

Oil Engine Compressor.
Chicago Pneumatic Tool Co.

Pile Drivers, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Plug Drills.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Pumping Systems, Pneumatic.
Bury Compressor Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, Air.
Cameron Stm. PumpWks.A.S.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, AutomaticDisplac'ment
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, Steam.
Cameron Stm. PumpWks.A.S.
Stearns-Roger Mfg. Co.

Quarry Machinery.
Bury Compressor Co.
Cameron Stm. PumpWks.A.S.
Chicago Pneumatic Tool Co.
Hartford Contrs. Supply Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Rock Drills, Air and Steam.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Rock Drill, Electric-Air.
Stearns-Roger Mfg. Co.
Ingersoll-Rand Co.

Sand Blast Equipment.
Pangborn Corporation.

Sand Blast Machinery.
Ingersoll-Rand Co.

Sand-Blast Rooms.
Pangborn Corporation.

Sand Riddling Machines.
Chicago Pneumatic Tool Co.

Separators, Air.
Griscom-Russell Co.

Stone Tools, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Tank, Air.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Wm. B. Scaife & Sons Co.

Tools, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Unloaders.
Jarecki Mfg. Co.
Yarnall-Waring Co.

Vacuum Pumps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Water Traps.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

TRADE MARK

RUBBER THAT OUTWEARS METAL

Rubber, wood, glass and various metals were subjected to a sandblast test by Goodrich chemists—The rubber at the end of the test was found to have suffered least from the pulverizing effects of the blast.

Properly made Rubber Hose—made the Goodrich way—withstands an incredible amount of abuse and still holds up.

Your air-drills do better work with Goodrich Hose behind them. Your boiler tubes will be cleaner with Goodrich Boiler Washout Hose behind the scale remover.

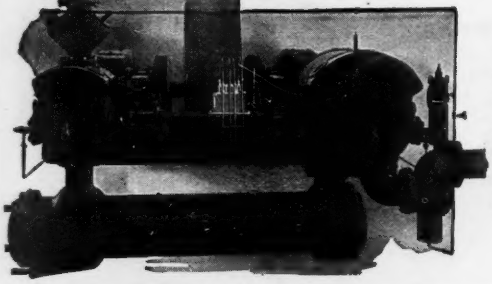
Goodrich makes Hose for every possible mechanical need. To specify "HOSE—GOODRICH" is cheapest in the end. Since the first Goodrich Rubber Product —Hose—nearly fifty years ago, this gigantic organization has made more miles of Rubber Hose than any other concern in the country.

Samples and expert co-operation are at your service without charge.

THE B. F. GOODRICH RUBBER COMPANY
The City of Goodrich—Akron, Ohio

Goodri h De Luxe Truck Tires suffer least from the disintegrating effects of the road. Their high crown of toughest rubber gives greatest mileage.

GOODRICH
AIR DRILL HOSE



McCord Class 'B' Lubricating the Cylinders of a Two-Stage Ingersoll-Rand Imperial Air Compressor.

SAYS A NEW ZEALAND ENGINEER

I have just fitted your Force Feed Lubricator, tag 21799, to an Ingersoll-Rand Air Compressor, and I find it fully justifies your claims. It can be regulated to a nicety. I would be glad if you would forward me your catalogue, "Force Feed Lubricators" and "McKim Gaskets," and oblige

Yours faithfully,
JOHN A. MILNE, Engineer.
Post Office, Otira, Westland, New Zealand.

McCord Force Feed Lubricators

are saving oil and time in Air Compressor plants all over the world.

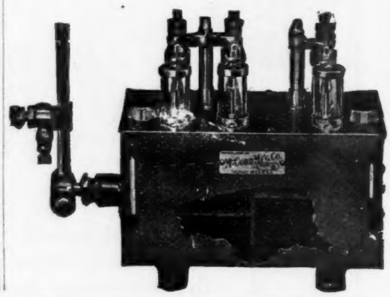
If your requirements call for a lubrication system which supplies just the right amount of oil—at just the right time—in just the right place—INVESTIGATE the "McCord" at once.

For complete details and liberal free trial offer—address

McCORD MANUFACTURING CO.

2587-2631 Grand Boulevard East DETROIT, MICH.

Two Compartment Class "B" McCord Force Feed Lubricator Compressor Unit and Power Unit With Different Kinds of Oil at the Same Time



It Removes Water from Compressed Air

Follow the path of flow in the sectional view of the

Stratton Air Separator

The terrific centrifugal force developed by the flow of air literally **tears** the water from the air and sends the air into the pipes perfectly dry.

Send for Bulletin 1110

TheGriscom-RussellCo.
2117 West Street Building
New York

USE ONLY

BULLDOG STEEL

"It Reigns Supreme."

HOLLOW AND SOLID

EVERY SIZE IN STOCK

Trade Mark. Reg. U. S. Pat. Off. 1911.

"Bulldog Special" Hollow Drill Steel is used with all Drills, wherever the BEST is needed.

Manufactured Only by the

International High Speed Steel Co.

Main Office and Works—Rockaway, N. J. **New York Office—294 Lafayette St.**

The Armstrong Method

is the mechanical method, a logical addition to the other mechanized operations of mining. The Armstrong Shovel is a compressed air-operated machine, only 6 feet in length, 4 feet wide, 4 feet high, and requiring only 6 feet 10 inches headroom when working.
Its loading capacity is 45 tons per hour.

The Armstrong shovel occupies so little space and requires so little headroom that it can be used in practically any underground mining operation. With its use the rate of progress is no longer dependent upon the speed with which the muck can be removed, but depends upon the rate of drilling—a complete reversal of former conditions.

MECHANIZE UNDERGROUND!

Send today for Bulletin A. S. No. 1 describing the Armstrong Shovel—You cannot afford to pass by this opportunity.

Lake Superior
Providence Building

CLASSIFIED BUYERS' GUIDE

Air Cylinder Oil.
Chicago Pneumatic Tool Co.

Air Lift Pumps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Air Receivers and Reheaters.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Stearns-Roger Mfg. Co.
Wm. B. Scaife & Sons Co.

Aftercoolers, Air.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Stearns-Roger Mfg. Co.

Air Jacks
Chicago Pneumatic Tool Co.

Belting.
Republic Rubber Co.

Blowers.
Cameron Stm. PumpWks.A.S.
Chicago Pneumatic Tool Co.

Blowing Engines.
Cooper Co., C. & G.
Ingersoll-Rand Co.

Catalogue Designers.
Jewett.

Channelers.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Charging Stations.
Porter Co., H. K.

Coal Cutters.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Compressors, Air and Gas.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Hartford Contr's. Supply Co.
Ingersoll-Rand Co.
Powell Co., Wm.
Stearns-Roger Mfg. Co.

Compressor Fittings, Air & Gas
Chicago Pneumatic Tool Co.
Powell Co., Wm.
Republic Rubber Co.

Compressors, Portable.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Compressor Regulators.
Chicago Pneumatic Tool Co.

Conveying Equipment.
Pangborn Corporation.

Core Drills, Diamondless.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Corliss Engines.
Cooper Co., C. & G.

Drill Chucks.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Drilling Machines, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Drill Sharpeners.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Drill Steel, Hollow and Solid.
Inter'l High Speed Steel Co.
Ingersoll-Rand Co.

Dust Exh.-Arrester Systems.
Pangborn Corporation.

Dust Handling Equipment.
Pangborn Corporation.

Drilling Stands.
Chicago Pneumatic Tool Co.

Electric Drills and Grinders.
Chicago Pneumatic Tool Co.

Electric Hammer Drill.
Chicago Pneumatic Tool Co.

Electro-Pneumatic Machinery.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Foundry Appliances.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Son Co.

Gas Engines.
Cooper Co., C. & G.
Hartford Contrs. Supply Co.

Gas, Gasoline and Oil Engines.
Chicago Pneumatic Tool Co.

Gaskets.
McCord Mfg. Co.

Hammer Drills.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Hammers, Calking & Chipping.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Hammers, Riveting.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Hoisting Machinery.
Lidgerwood Mfg. Co.

Hoists, Air.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Hose Coupling and Clamps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Hose, Steam and Air.
Chicago Pneumatic Tool Co.
Goodrich Rubber Co.,TheB.F.
Ingersoll-Rand Co.
Republic Rubber Co.
Stearns-Roger Mfg. Co.

Intercoolers.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Locomotives, Compressed Air.
Porter Co., H. K.

Lubricating Grease.
Keystone Lubricating Co.

Lubricating Oils.
Ingersoll-Rand Co.
Keystone Lubricating Co.

Lubricators.
McCord Mfg. Co.
Powell Co., Wm.

Meters, Air.
Ingersoll-Rand Co.
New Jersey Meter Co.

Mining Machinery.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Moister and Oil Separators.
Pangborn Corporation.

Motors, Air and Gas.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Motor Trucks & Ry. Motor Car
Chicago Pneumatic Tool Co.
Sprague Electric Works.

Oil Cups.
Powell Co., Wm.

Ore Concentrating Machinery.
Stearns-Roger Mfg. Co.

Photo-Engravers.
Jewett.

Oil Engine Compressor.
Chicago Pneumatic Tool Co.

Pile Drivers, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Plug Drills.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Pumping Systems, Pneumatic.
Bury Compressor Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, Air.
Cameron Stm. PumpWks.A.S.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, AutomaticDisplac'ment
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, Steam.
Cameron Stm. PumpWks.A.S.
Stearns-Roger Mfg. Co.

Quarry Machinery.
Bury Compressor Co.
Cameron Stm. PumpWks.A.S.
Chicago Pneumatic Tool Co.
Hartford Contrs. Supply Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Rock Drills, Air and Steam.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Rock Drill, Electric-Air.
Stearns-Roger Mfg. Co.
Ingersoll-Rand Co.

Sand Blast Equipment.
Pangborn Corporation.

Sand Blast Machinery.
Ingersoll-Rand Co.

Sand-Blast Rooms.
Pangborn Corporation.

Sand Riddling Machines.
Chicago Pneumatic Tool Co.

Separators, Air.
Griscom-Russell Co.

Stone Tools, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

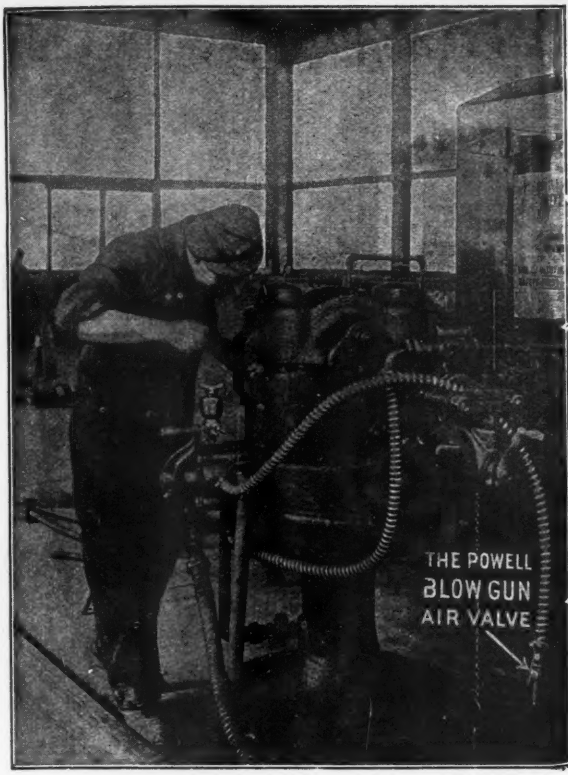
Tank, Air.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Wm. B. Scaife & Sons Co.

Tools, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Unloaders.
Jarecki Mfg. Co.
Yarnall-Waring Co.

Vacuum Pumps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Water Traps.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.



The Powell Blow Gun Air Valve

Cleans Bolt Cutters, Rock Drills, Boring Mills, Shapers, Planers and Engine Lathes, from Chips of various materials. Ever ready and conveniently attached.

Arms length from Machine Operator

Made in sizes 1-4 to 1 in. inclusive

Order a Sample on Approval
Send for Circular Today

THE WM POWELL CO.
DEPENDABLE ENGINEERING SPECIALTIES
CINCINNATI, O.

PORTER LOCOMOTIVES

Porter Compressed Air Locomotives are the safest and most economical haulers that can possibly be made. They generate heat from the atmosphere and are fireless. The cost of their upkeep is, therefore, negligible.

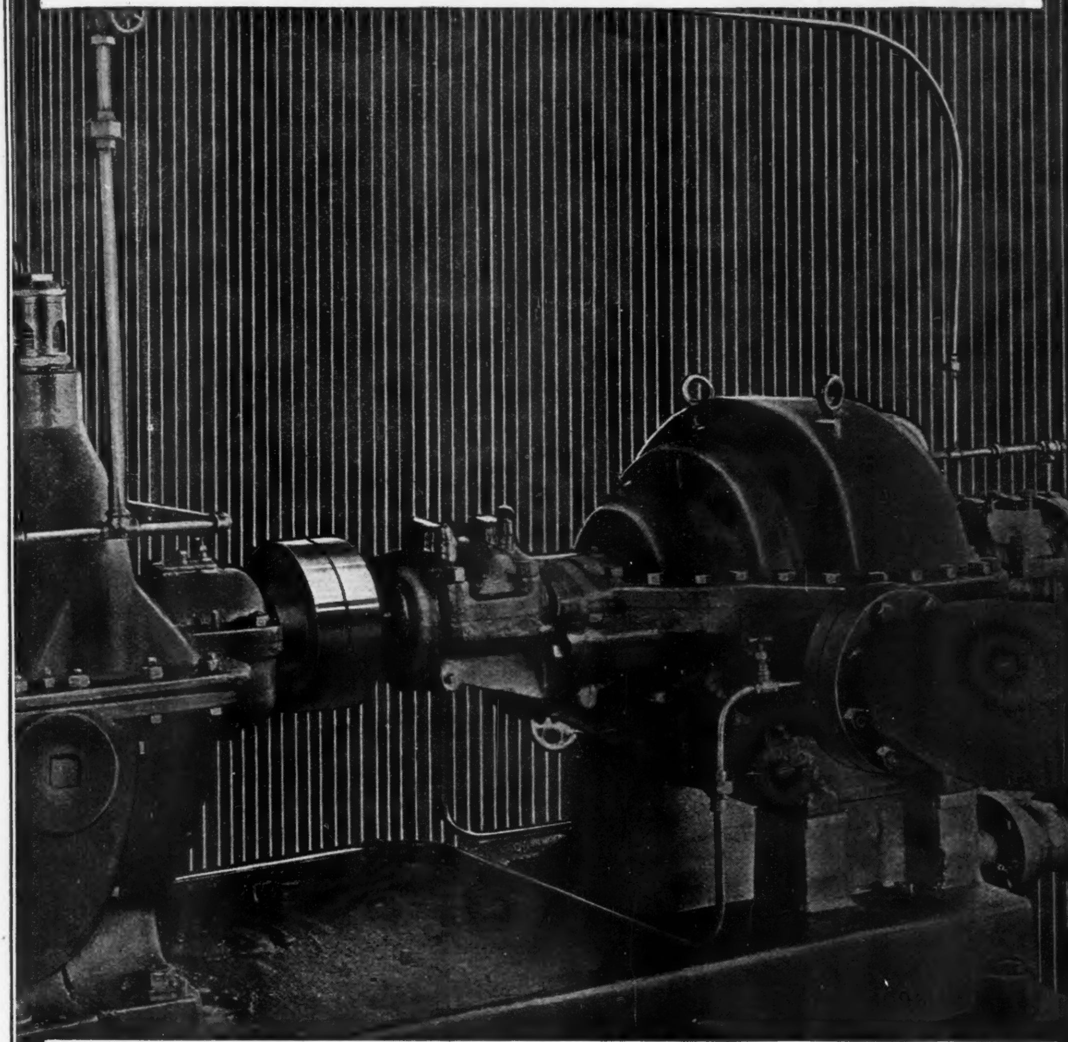
If you are contemplating using locomotives we will be glad to consult with you regarding the best type of locomotive for your particular work. Our new catalogue, which explains the advantages of compressed air haulage is yours for the asking. Write for one.

H. K. PORTER CO., Pittsburgh, Penna.

INDEX TO ADVERTISERS

As a matter of reciprocal business courtesy, help trace results

CAMERON PUMPS



The long period of night and day production enforced by war conditions, gave us ample proof of what machinery would stand up under constant service.

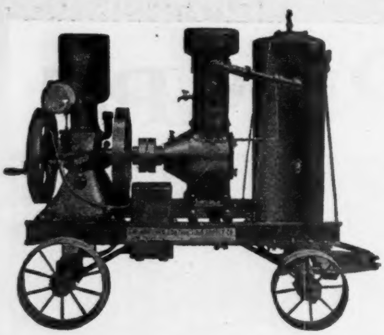
Cameron Pumps were used in many war industries, working a 24 hour day, and their admirable condition today inspires confidence in them for any and all pumping requirements.

Send for a copy of our useful handbook entitled "Hydraulic Tables." Free upon request.

A. S. Cameron Steam Pump Works

Offices the World Over **11 BROADWAY, NEW YORK**

62-DV



"Hartford" Portable Air Compressors

Mechanically perfect—Vibrationless—Compact—Hopper Cooled—Automatically lubricated—Protected Bearings—Dust Proof

Built for Permanence and Efficiency

in 23, 44, 118 and 210 cu. ft., F. A. P. M. sizes. Gasolene, Kerosene and Electricity. Send for Bulletin No. C2. It's an authority on "Built from experience plants."

The Hartford Contractors' Supply Co.

Designers—Manufacturers—Distributors

K. B. NOBLE, Pres.

Hartford, Connecticut

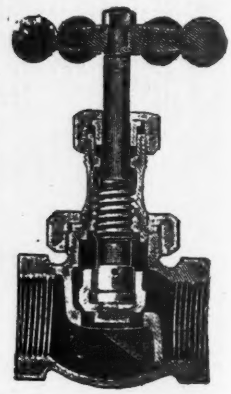
Regrinding Valves

Our regrinding valves are made of the very best quality of steam metal, of superior workmanship and all parts made to template and gauges so repair parts can be supplied accurately. We are prepared to make prompt shipments and respectfully solicit your orders and inquiries.

McNAB & HARLIN MFG. CO.

Office—55 John Street, New York City

Factory—Paterson, N. J.



THE ERIE UNLOADER—NEW STYLE

For Single, Duplex and Multiple Stage Steam, Belt or Electric Driven

AIR COMPRESSORS

Maintains practically a constant air pressure, whatever the requirement. Completely unloads and loads Compressor without shock or strain.

Circulars on application to

JARECKI MFG. CO., ERIE, PA.

Also Compressor Governors

The "OLDHAM" IMPROVED LONG STROKE RIVETER

LIGHT
FAST
POWERFUL

The springs connecting the handle and cylinder absorb all shock and remove the possibility of broken handles, cracked cylinders and stripped threads.

3 Sizes: 6, 8 and 9-in.

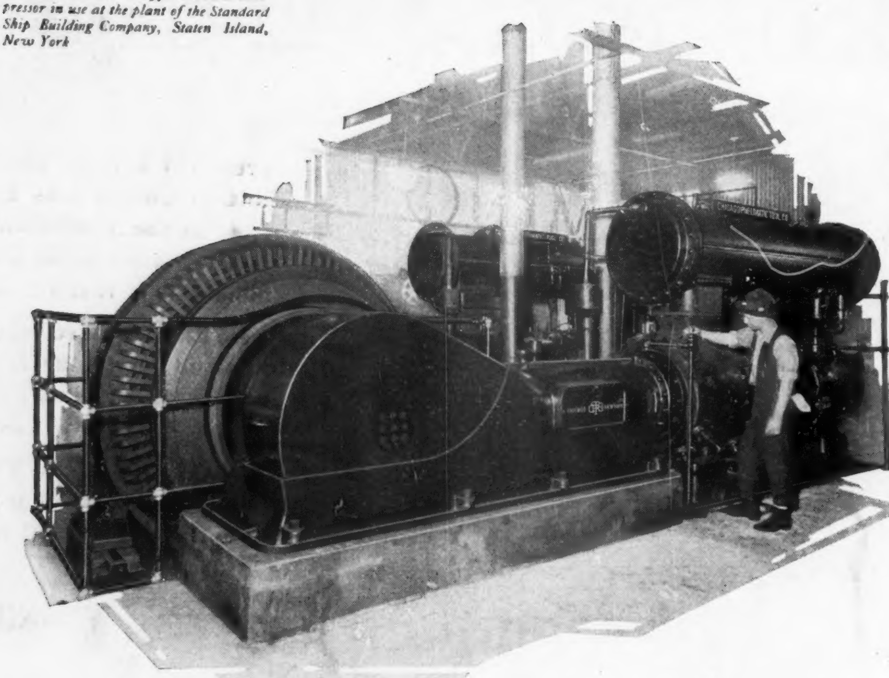
Tools Sent on Approval

George Oldham & Son Company Pneumatic Tools and Appliances

FRANKFORD, PHILA., PA.

As a matter of reciprocal business courtesy, help trace results

"Chicago Pneumatic" Type O-CTDE Compressor in use at the plant of the Standard Ship Building Company, Staten Island, New York



The Compressor with the "Simplate  Valve"

Every "Chicago Pneumatic" Air Compressor is equipped with the patented "Simplate" Flat Disc Valves. These valves require no lubrication and are practically indestructible. Operating silently and efficiently, they automatically adjust themselves to all load demands, increase mechanical and volumetric efficiencies, and simplify the whole problem of compressor operation and maintenance.

The "Chicago Pneumatic" line of air compressors comprises over 300 distinct sizes and types. Any compressor need is met by at least one. All are characterized by exceptionally large bearing surfaces, automatic lubrication, simple, sturdy construction and automatic regulation, which insures operating economy under variable load conditions. "Chicago Pneumatic" Air Compressors are, in every detail, thoroughly modern machines, the result of over 20 years' experience in building compressors for every conceivable need.

Write for Bulletins

Chicago Pneumatic Tool Company

1027 Fisher Building, Chicago, Illinois

BOYER PNEUMATIC HAMMERS · · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · VACUUM PUMPS · · GIANT FUEL-OIL, GAS,
GASOLINE AND STEAM ENGINES ROCK DRILLS · · · COAL DRILLS

CHICAGO PNEUMATIC

Depend upon that Name